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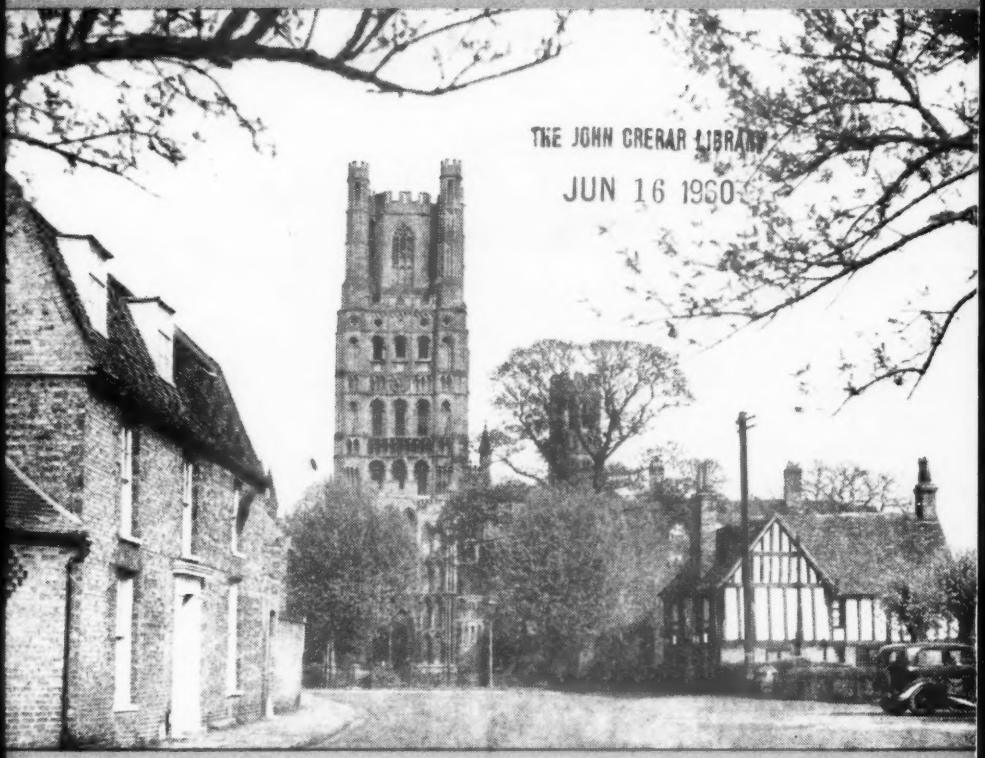

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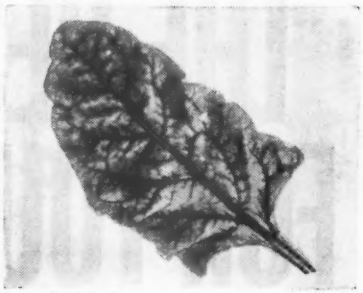

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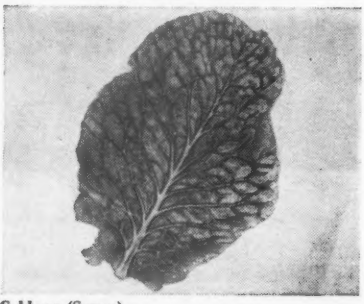

Cabbage (Savoy)—
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Beans—
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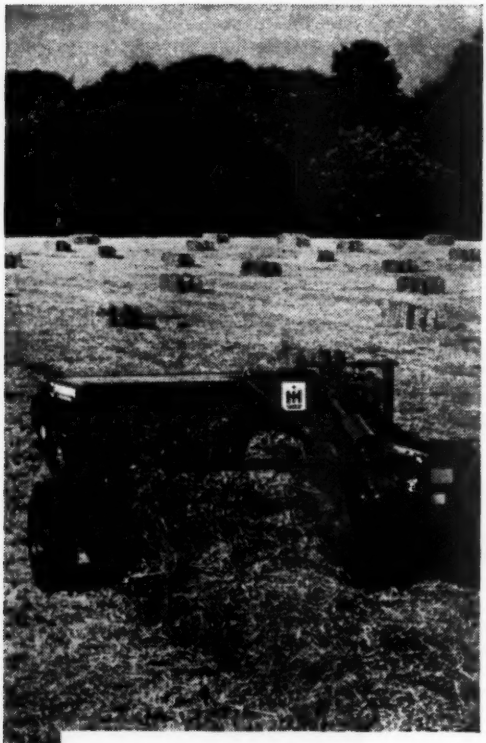

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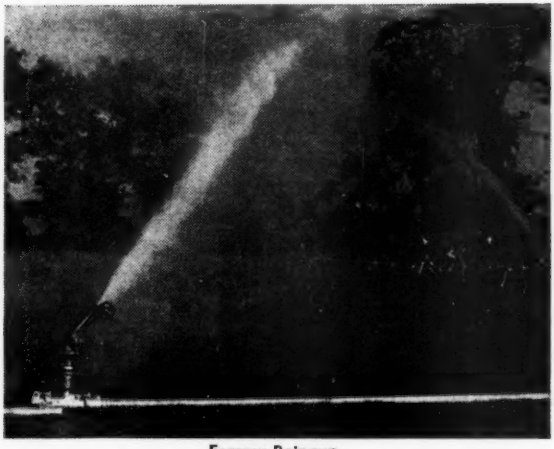

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Agriculture

Volume LXVII Number 2 May 1960

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Cover photograph: Ely cathedral—the West Tower across the Green *Photo: Mustograph*

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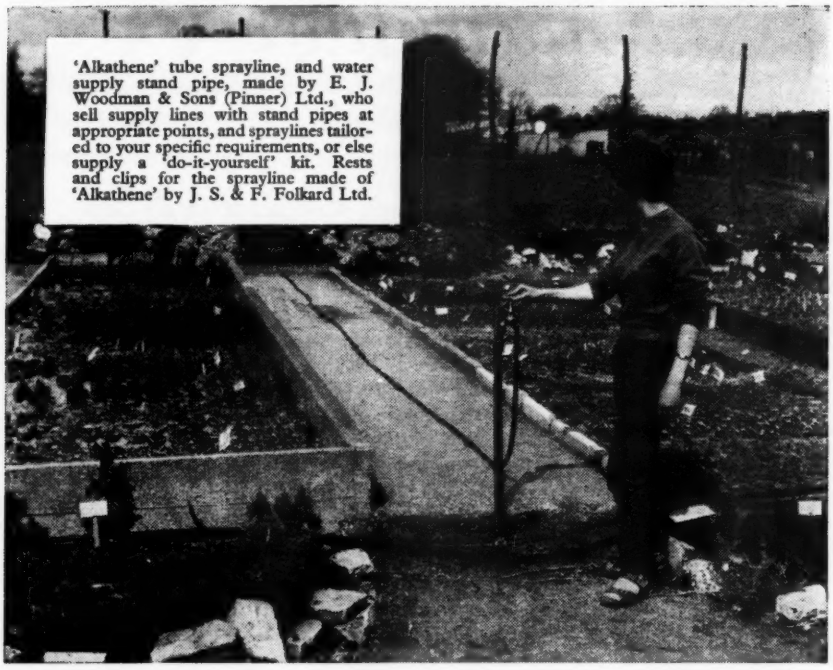

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Economics of Irrigating Farm Crops

J. S. NIX, M.A.
School of Agriculture, University of Cambridge
and
C. N. PRICKETT, A.M.I.C.E.
Ministry of Agriculture, Fisheries and Food

The authors consider the capital costs of portable and fixed equipment, and the yield increases which may be needed to cover costs. Remarkable results have been achieved—sufficient to justify very high initial costs in some cases; but the equipment must be used with precision if it is to pay.

As was to be expected following the drought summer of 1959, the interest shown in irrigation during the past winter has been considerable. Technical matters such as types of equipment and sources of water supply have been widely discussed, but relatively little has been heard of the economics of the subject. This article considers briefly some of the economic questions that arise with farm crops grown on a field scale.

First, what does it cost to irrigate? Two surveys have been carried out in recent years to provide information on this question. In one, the Farm Economics Branch of the Cambridge University School of Agriculture investigated some thirty farms in the Eastern Counties. These farms had irrigation plants costing between £360 and £3,500; most of them used the rotating sprinkler system, had mainly portable equipment and were fortunate enough to have free water, usually from rivers. Such plants predominate at the present time.

The other survey, made by the Ministry of Agriculture's Land Drainage and Water Supply Division, was carried out on only fifteen farms but went into greater detail than the Cambridge study. The cost of the plants on these farms, which were more widely scattered over the country, ranged from £540 to £5,000. Again, sprinkler lines, portable equipment and free water predominated, but a rather higher proportion had some fixed equipment.

The Cambridge survey showed an average cost of £2 6*s*. per acre-inch, that is, for each inch of water applied to one acre. Of this cost, more than half (£1 5*s*.) consisted of the fixed costs of the equipment, namely depreciation and interest. The remaining £1 1*s*. covered the variable, or running costs—mainly labour and power, each of which cost 9*s*. 6*d*. an acre-inch. Power was provided almost entirely by tractors, fuel comprising a third of this cost. Miscellaneous costs such as repairs and tractors and trailers used for moving pipes amounted to 2*s*. an acre-inch.

Costs varied widely from farm to farm: from 18*s*. to £4 2*s*. an acre-inch. Fixed costs varied in particular: on one farm they were as low as 6*s*., on another they were as high as £2 6*s*. an acre-inch. Fixed costs per acre-inch depend primarily on two factors: the initial cost of the equipment and the extent to which it is used. Two farms in the Ministry sample had excep-

tionally high fixed costs, because their equipment was little used; as a result the average fixed costs in the Ministry study were nearly £1 an acre-inch above these in the Cambridge survey. If it had not been for these two farms, the average costs in the two surveys would have been very similar.

The farm to farm differences in variable costs were smaller, but still substantial. Labour is required to move sprinkler lines or rain guns, to attend to the pumping equipment, and to move portable equipment from one part of the farm to another. Many farmers complained that the labour requirement was greater than they had supposed when buying the equipment. In particular, moving portable equipment around the farm takes time, and is more difficult to plan than the regular shifts of sprinkler lines or rain guns within a field. Labour required for these jobs is often urgently wanted elsewhere on the farm at the same time—for hay- or silage-making or beet hoeing, for example. The periodic demands for extra labour to move portable mains may be reduced—or even removed—by installing fixed mains, but these can be costly. We shall return to this point later. Having a man constantly in attendance on a smallish plant can also cause higher labour costs. In the two surveys, labour costs varied from 3*s*. to £1 3*s*. an acre-inch.

Capital costs—portable equipment only

What is the plant likely to cost? Let us assume first of all that the farmer has a river running through his farm, and that he intends to use only portable equipment. The type of tractor-driven pump used on most of the surveyed farms costs about £200, with all accessories. There are cheaper pumps available.

The length of main required will depend on the situation of the fields to be irrigated in relation to the source of water. If most of the crops to be irrigated can be grown close to the river, mains cost might be very low; but if they are to be grown as part of the same rotation over the whole of a largish farm, mains will have to be supplied to reach distant fields, and costs might be heavy. The longer the distance the greater the cost per yard run, if pipes of larger diameter are needed to reduce friction loss as distance increases. A quarter of a mile of 4-inch main will cost about £500, but half a mile of half 4-inch and half 5-inch main will cost approximately £1,150.

A sprinkler line with enough sprinklers to irrigate one acre at a setting will cost about £275, and two acres £550. If the equipment applies an inch in three hours and takes half an hour to move, four acres can be irrigated in a 14-hour day. It is not essential for a man to be in constant attendance. On this basis, a farmer could irrigate nearly 50 acres in a two-weeks' cycle. However, since most technical advisers on irrigation recommend a ten-day cycle in a summer drought, it is perhaps wiser for best results not to reckon on a "one acre set" doing more than forty acres, unless the farmer is prepared to work the plant all night in a drought in midsummer. Many farmers in fact do this, to keep down their outlay on sprinkler line. Obviously this necessitates getting up in the middle of the night to move the line, unless there is grass on the farm which might be given two inches at a setting. The more time that is likely to be lost through having to move portable pipe round the farm, the smaller the acreage a given plant will be able to cover in a given cycle period.

The lowest initial cost will be where rivers or dykes run alongside all the irrigated fields. Even here a small length of main will be needed, to avoid having to move the pump at every setting; forty yards should allow five settings from the same pump position. The initial cost will be about £550, or £11 an acre irrigated at 50 acres per "one acre set", and nearly £14 at 40 acres per "one acre set". Adding a quarter of a mile of main nearly doubles the cost. Two acres of sprinkler line and a quarter of a mile of main costs £1,250—£12 10*s*. to £15 10*s*. an acre irrigated (100 and 80 acres "per cycle" respectively), and with half a mile of main £1,900—£19 to £24 an acre.

The above approximate costs all refer to an acreage to be irrigated in a regular cycle. "Out of season" irrigation may also be practised—on spring corn on light land in a dry spring, for example—without any addition to fixed costs.

Capital costs—fixed equipment

When fixed equipment is installed, costs are likely to rise substantially. An exception to this is the use of fixed mains on a long, narrow farm with the water source at one end. Because a 40 per cent grant can be obtained with a private water supply (25 per cent if a public supply is used) the cost per yard run net of grant is less than that of portable mains, and labour costs also are reduced. However, a given length of portable mains can be used in many different parts of the farm, and will bring more land within reach of irrigation on most farms than the same length of permanent pipe.

Borehole costs are very variable, depending in particular on the depth required and the nature of the strata. The average cost is about £3 a foot. In addition, more expensive submerged pumping arrangements are required. In east Suffolk, some recent boreholes, with pumping installations, have averaged £1,400 for an output of up to 10,000 gallons an hour—enough to put one inch of water on 1¼ acres in three hours. At this figure, even after the deduction of a 40 per cent grant, initial costs are increased by about £15 an acre irrigated.

With the rapidly increasing popularity of irrigation, more and more attention is inevitably—and rightly—being paid to the provision of reservoirs, in order particularly to preserve the winter surplus of water. As with boreholes, reservoir costs vary considerably, even for a given capacity. To take an example, assuming an earthworks cost of 4*s*. a cubic yard, and that for each cubic yard of earth moved two cubic yards are available for water storage (through, for example, banking up the sides with the earth removed), the cost amounts to approximately £15 an acre-inch of water, allowing for some seepage and evaporation. If the irrigator is relying solely on reservoir water stored in winter, and if five inches an acre is required in a dry year, then the reservoir would cost £75 an acre irrigated. Even allowing for a 40 per cent grant, this sum corresponds to £4 10*s*. an acre per year, calculating depreciation over fifteen years, apart from the loss of profit on the land flooded. But the cost in any particular instance may be very different from this. At one extreme, an earth reservoir may have to be created entirely by excavation, a cubic yard of earth having to be moved for every cubic yard of storage produced. On the other hand, in a good site—for example, damming a well-defined valley with not too much longitudinal slope—the storage to earth-

works ratio might be 5 or more to 1. Even in this case, however, the spillway and other works can be costly. Furthermore, earthwork costs per cubic yard vary widely.

Thus, while with river water and portable mains initial costs may be broadly £15–25 an acre irrigated (£2–3 5*s*. an acre per year), boreholes and reservoirs would add considerably to this figure. With expensive source works and an elaborate network of fixed mains, capital costs could, in difficult circumstances, exceed £80 an acre irrigated, even after deducting grants. This would mean fixed costs of at least £8 an acre per year.

Yield increases needed to cover costs

More information is slowly becoming available on the yield increases obtainable from irrigation. There are so many variations, however—in seasons and soils apart from anything else—that it is not yet possible to forecast the average yield increases that might be expected on a particular farm.

It is possible, however, given a reasonable estimate of the level of costs, to calculate the yields required to cover costs. For example, with free water, an initial cost of £20 an acre irrigated, and running costs at £1 an acre-inch, the cost per acre will be approximately £5 5*s*., if an average of 2–2½ inches of water is applied a year. To cover these costs, sugar beet yield increases would have to average a ton a year (at 16·5 per cent sugar content), and potatoes between a quarter of a ton (when scarce and prices are high) and three-fifths of a ton (when plentiful and prices are low). These increases allow for the extra costs of harvesting a heavier crop.

The problem is more complicated with grass, particularly as increased fertilizer use is normally an integral part of increasing grassland productivity through irrigation. With dairying, there are several alternatives. Milk production may be increased either by obtaining higher yields per cow from the same acreage and quantity of concentrates fed, or by increasing the stocking rate. Alternatively, the same milk production may be obtained either from fewer acres—thus releasing land for cash cropping—or with fewer concentrates, through the partial substitution of grass and grass products. Whichever method or combination of methods is chosen, "break-even" points can be calculated.

The required yield increases given above for sugar beet and potatoes represent yearly averages. The great benefit in years like 1959 would have to balance the much smaller benefit, or even complete lack of it, obtained in wet years such as 1958, when the equipment might never leave the barn. Such evidence as exists indicates that increases exceeding those described above can easily be achieved on most soils in the drier parts of the country.

However, if boreholes have to be sunk, reservoirs built, or mains water bought, the "break-even" yields are substantially increased and the installation of irrigation equipment must be considered extremely carefully on the individual farm. Mains water, rarely available for farm irrigation, increases costs by nearly £3 an acre-inch at 2*s*. 6*d*. a thousand gallons, or nearly £7 an acre for an average use of 2¼ inches a year. In addition, water suppliers often require storage in conjunction with a mains supply, which increases costs still further.

Nevertheless, some results obtained on dry soils in dry areas have been

remarkable, and would justify very high initial costs indeed. These include the experiments at Gleadthorpe Experimental Husbandry Farm, where average sugar beet yields on fully-irrigated land have been more than six tons an acre higher than on non-irrigated land during the period 1955 to 1959, and potato yields more than three tons an acre higher over the same period, mainly through startling increases in 1955 and 1959.

A final word of warning is needed, however. Experiments are usually conducted by experts who give much of their time to ensuring that the crops are accurately irrigated as and when required. Many a farmer has found his own results disappointing, and this is largely because he has not had time to give irrigation the accurate attention needed for the best results. But if the plant costs him a lot of money in fixed equipment and reservoirs, he must do the job properly, otherwise he may be a net loser from the investment.

Irrigation of Early Summer Cauliflower

P. J. SALTER, M.Sc. (HORT.), PH.D.

National Vegetable Research Station, Wellesbourne, Warwick

Few crops respond so generously or so consistently to irrigation as early summer cauliflower. The best irrigation treatment, after the plants have become established, is to irrigate whenever the soil moisture deficit reaches one inch.

As long ago as 1731 it was noted that "collyflower" required frequent watering in dry weather,[1] and today it is generally accepted that the early summer cauliflower is one crop that responds markedly to irrigation. It has, in fact, been stated that ". . . there is very little land in the east of England capable of producing first-class summer cauliflower without artificial watering."[2]

A calculation of the frequency of irrigation need, from measurements of average summer rainfall and average summer potential transpiration, has been made for the main horticultural areas in this country,[3] and it supports this statement. The data indicate that even in Worcestershire, a Midland county important for early summer cauliflower production, irrigation would be required at least six years out of ten—otherwise growth and yield of this crop would be adversely affected.

Although the need to irrigate is appreciated, each grower has his own views on the timing, quantities of water to use and method of application. As a result there is no general policy followed when irrigating this crop, but present practices might be summarized as follows: during the early growth stages, while the plants are growing in cold glasshouses or frames, they are often deliberately kept short of water to encourage the production of sturdy plants. After planting in the field, irrigation is usually given at infrequent intervals until the curds begin to appear.

Recent experimental work over a number of years at the National Vegetable Research Station, and at some of the experimental horticulture stations of the N.A.A.S., has now provided some information on the response of the early summer cauliflower crop to irrigation under different climatic conditions. It is hoped that the results obtained from this work, which is still continuing, will enable growers to irrigate this crop with the best use of equipment, labour and water available.

Water once a week in winter

It is a common practice to sow the cauliflower seed in late September or early October, overwinter the plants under cold glass, and plant in the field in early spring. During the winter the plants are watered sparingly, and in some areas[4] they are allowed to turn blue or even wilt as a result of water shortage, to grow a sturdy type of plant able to withstand adverse conditions.

Results from experiments have shown, however, that when young cauliflower plants were watered frequently (three times each week) throughout the winter period, the plants produced were much larger than those watered in the normal commercial manner; furthermore, they withstood hard weather after planting and produced larger curds at cutting time. Plants kept short of water during the early stages of growth had produced a smaller number of leaves, and this may have been a contributory cause of the smaller curds which they formed.

The results of these experiments suggest that it would be beneficial to water at least once a week during the winter to prevent the young plants from showing symptoms of water shortage, for a small expenditure of water and labour at this time could appreciably influence the curd size at cutting.

Critical experiments to determine the effects of irrigation after planting in the field were first carried out with equipment which allowed the plots to be covered from rain, so that strictly controlled treatments could be maintained. The results from these first experiments showed that at least a quarter of the available water in the root zone could be used by the crop before irrigation was required to maintain maximum growth rate.[5]

This was equivalent to a soil moisture deficit of a quarter of an inch just after planting and one inch at cutting time. Maximum growth and maximum marketable yield were obtained when no restriction was placed on either the frequency of irrigation or the total quantity of water used. However, in commercial practice it is desirable to irrigate as infrequently as possible and to economize in the quantity of water used.

Reducing irrigations to a minimum

In attempts to reduce the number of irrigations to a minimum, increasing attention has been paid by research workers to the particular periods during the growth of a given crop when a high level of soil moisture is required, or conversely, when irrigation is not required, to obtain maximum marketable yield. In contrast to some vegetables, early summer cauliflowers have shown no marked periodicity in their water requirements in the field; the results of all experiments to date suggest that they must be kept growing strongly without checks to growth, if maximum yields are to be obtained. Frequent appli-

cation of small quantities of water is the surest means of obtaining this end.

In view of the need to economize in water, labour and equipment, the number of irrigations and the volume of water applied should be reduced to the minimum consistent with obtaining a worthwhile return. By irrigating with larger quantities of water at longer intervals of time it is possible to get good, though not maximum, yields. It can be regarded as a general rule, not only for the cauliflower crop, that the return per unit cost of irrigating is greatest for a single application of water and diminishes with increasing number of irrigations per crop; in fact, the law of diminishing returns operates. To illustrate this particular point the results of an irrigation experiment on early cauliflowers at Wellesbourne in 1959 may be quoted. Four treatments were compared; namely, no irrigation, a single irrigation just before harvest, irrigation whenever the soil moisture deficit reached one inch (this happened twice), and whenever the soil moisture deficit reached half an inch (irrigated six times). The mean weight of the plants and the mean curd diameters resulting from these four treatments were respectively 2·1 lb and 4·5 inches; 2·8 and 5·1; 3·0 and 4·9; and 3·6 and 5·3.

The highest yield was obtained when the crop was irrigated six times, but the most economic treatment would be the single irrigation before harvest, which increased the plant weight by 33 per cent and the mean curd diameter by over half an inch. In 1959, however, the weather was exceptional, for at Wellesbourne frequent rain during March and April enabled the plants to become firmly established without irrigation before the dry weather started, and they were able to maintain satisfactory growth well into May.

Best treatment for early cauliflower

Present information suggests that the best practical irrigation treatment, after the plants have become well established, is to irrigate early cauliflower whenever the soil moisture deficit reaches one inch. The average use of water by an early summer cauliflower crop would be at the rate of about a tenth of an inch a day during rainless weather, so that an irrigation of one inch of water would be required at approximately 10-day intervals. In showery weather, irrigation would not be needed so often, whilst with lighter soils which hold less water, more frequent irrigation would be necessary.

More accurate methods of assessing soil moisture deficit are now available to help growers to eliminate guess-work. One way involves the use of an instrument, now on the market, which gives a continuous indication of soil moisture deficit in the soil;[6] another method, fully described in a recent Ministry publication,[3] enables the soil moisture deficit to be estimated.

The time to start field irrigation of early summer cauliflowers depends on the weather. It is especially important that the plants should establish themselves quickly after planting, so the first irrigation may be necessary at this time. The stage of crop growth at which to stop irrigating is a much more controversial problem. Some growers hold that watering must be withheld immediately the curds start to form, because from then on watering is no longer required by the plant and browning and rotting of the curd may result; others recommend irrigation once a week during the harvest. At the moment there is not enough evidence to prove or disprove either of these views, but some experimental results suggest that irrigation during the har-

vest period is worth while. Provided irrigation is given in the early morning or evening, or during dull weather, harmful effects are unlikely.

It is generally agreed that irrigation is one of the ways in which crop yields per acre can be further increased in this country. But it is unlikely that unlimited supplies of water will ever be available for irrigation purposes, or that there will be sufficient equipment or labour on any holding to irrigate all crops at any one time. The farmer and grower must therefore give certain crops priority for water, because of their high value and the way they respond to irrigation. Undoubtedly early summer cauliflower commands a high priority for water when mixed vegetable or farm crops are grown. Rainfall figures indicate that irrigation would benefit this crop when grown in the drier areas, such as the Midlands or east of England, in nine years out of ten. There are not many cultural operations carried out by growers that can offer such odds for increasing yield, or many crops grown in this country which respond so consistently to irrigation.

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Don't Poison the Bees

Bees are good friends of farmers and fruit growers. Don't kill them with insecticides and weed-killers. Take the following precautions:

1. Don't use insecticidal sprays or dusts on open blossom in orchards or on seed crops in flower, especially rape, mustard and other brassicas, which should be sprayed *before* the blossom opens.
2. Carry out chemical weed control on cereal crops before the weeds reach the flowering stage. This applies particularly to charlock, whose flowers are very attractive to bees.
3. Never use arsenic in orchards except *before* the flower buds open and *after* complete petal fall. Arsenic is deadly to bees.
4. Clean cultivate or gang-mow orchards immediately before applying poisonous chemicals.
5. Avoid letting sprays and dusts drift on to hedgerow flowers or neighbouring fields where bees are foraging.
6. Take care not to dump waste chemicals or empty containers where they may contaminate ponds or other places likely to be used by bees for drinking.
7. If you are a bee-keeper, be on the look out for local crops likely to be treated, and approach the growers about the timing of pest control operations, or obtain a warning of impending action.

Dangers of Uncooked Waste Foods

(in relation to Foot-and-Mouth Disease, Swine Fever and Fowl Pest)

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Waste foods play an important part in animal feeding in Great Britain. The feeder must appreciate his responsibility to the community, and ensure that there is no dissemination of the highly infective viruses which such waste may contain.

THE danger of swill carrying the virus of foot-and-mouth disease, swine fever or fowl pest is not an auld wives' tale or a young intellectual's theorizing. It is cold, hard, never-to-be-forgotten fact.

There is a time in the affairs of a virus when it is beginning to multiply in the tissues, but has not yet reached the stage of producing clinical disease. Stock slaughtered at this stage may pass undetected the ante-mortem and post-mortem inspections in the slaughterhouse which are the first lines of defence. Raw or imperfectly cooked scraps and trimmings from infected carcasses and offal present the greatest danger.

The importance of waste food for animal feeding is indicated by the fact that from 1940 to 1953 local authorities in Great Britain collected 4,471,000 tons, and produced concentrate from that to the value of £14,344,000.

Early workers showed that the virus of foot-and-mouth disease could remain alive in bone marrow for over two months at temperatures normally used in the meat trade. Such bones fed in a crushed form to pigs produced clinical disease. This is the scientific basis for legislation in connection with the feeding of waste foods to stock, and its importance can never be over-emphasized.

More recent experiments by the Pirbright Research Institute have proved that in chilled and frozen liver, kidneys and lymph nodes the foot-and-mouth disease virus can survive for from four to five months. Swine fever virus may remain active in frozen pork for upwards of 1,500 days and for at least 27 days in bacon processed by pickling in sugar, potassium nitrate and common salt solution, followed by drying and smoking. The virus of fowl pest is known to remain active for at least six months in frozen carcasses.

The menace of meat trimmings and raw scraps in waste food is obvious. Any swill bin will contain tissues in which these three highly infective viruses may be present; there they can remain viable until destroyed by heating, but should any escape destruction they may strike with dramatic and sometimes serious consequences.

Spread of disease

In the years 1950 to 1958 inclusive, thirty-nine primary outbreaks of foot-and-mouth disease were attributed to swill. This figure takes no account of the secondary cases which may result.

In 1959, widespread dissemination of infection resulted from foot-and-mouth disease in pigs on the premises of a swill feeder. Pigs from these premises, sold at the county town market, caused a case 200 miles distant. Three other cases arose from this market, and local spread produced four more, all in the same county. In addition, pigs sold from the primary case were responsible for an outbreak on neighbouring premises which caused even wider spread of disease. Pigs from this latter owner caused another case locally, disease in two abattoirs, and originated two further series of outbreaks. The first began in an abattoir eighty miles away, which adjoined the cattle market, and cattle exposed therein became infected, resulting in two cases in that county, one in the adjoining county, and a fourth in an abattoir 100 miles to the north. This latter infection gave rise to another case locally by removal of cattle from the abattoir lairages. The second series started with an outbreak in an adjacent county through the direct movement of pigs. Local spread produced six further outbreaks in that county and three in another. Infection was also spread by indirect means to premises 180 miles distant. Thus from the original focus of infection we had twenty-nine secondary outbreaks in nine different counties.

Earlier in 1959, disease originated in cattle which had strayed on to a piggery and had contact with raw swill known to contain imported meat scraps. Three secondary cases resulted in the neighbourhood.

Foot-and-mouth disease is one of the most infective and rapidly spreading diseases known, the main reasons being the very large amount of virus manufactured by the affected animal, the long periods for which the virus may survive, the ease with which a susceptible animal may be infected, and the short incubation period of the disease. Because of this, eradication necessitates slaughter of the infected stock and their contacts, and the imposition of restrictions over a considerable area. Any fault in the swill feeder's process may endanger not only his own stock, but perhaps that of the whole neighbourhood, and cause financial loss and inconvenience to the agricultural community of the district.

Swine fever is a common swill-borne disease. Between 1950 and 1958 inclusive, imperfectly-treated waste food was responsible for 1,475 primary outbreaks. In considering the serious economic aspect of these figures we should not forget the animal suffering involved. Anyone who has seen pigs affected with acute swine fever will not readily forget the picture of utter misery they present. These figures take no account of secondary outbreaks which may have arisen from these foci of infection. In the first six months of 1959, forty-eight primary outbreaks of swine fever were attributed to swill—thirteen per cent of the total in that period. The virus may reach swill through imported pork or bacon, and home-bred pigs slaughtered in the incubative or the recovered "carrier" stage.

All swill feeders are advised to vaccinate against swine fever. Crystal violet vaccine properly administered gives a high degree of protection. Pigs should not be fed swill before vaccination, or until fourteen days after vaccination. Use of the vaccine obviously does not reduce the obligation to ensure that swill is effectively handled.

A third serious hazard of swill feeding is fowl pest. In 1926 a particularly virulent disease appeared among poultry near Newcastle-upon-Tyne. Doyle investigated, and isolated the virus causing the disease. He described the

condition fully, and it came to be known as Newcastle disease, a synonym for fowl pest. The food of the affected birds included offal collected at the port, and it was thought likely that disease had been introduced by infected food from a ship. Within a quarter of a century of first being identified, Newcastle disease was present in every continent, and was a menace to the poultry flocks of nearly every nation.

There was a further serious "strike" in Great Britain in February 1947. This strain of the virus was particularly dangerous; the symptoms were unmistakable and mortality was high. By the end of the year 2,222 outbreaks had been confirmed. The origin of disease in this series was indisputable, as the virus of fowl pest was recovered at the Ministry's laboratory at Weybridge from the carcasses of poultry which had been imported from Central Europe. In view of the widespread dissemination of infection through swill, the requirements for boiling waste food were extended to include that fed to poultry.

The early history of fowl pest in this country has been closely related to swill. Only a fraction of the swill produced is intended for poultry feeding, but poultry straying in a yard will always be attracted to raw swill. From 1953 to 1958 inclusive, 136 flocks were believed to have become infected through waste food, and in the first six months of 1959, thirty cases were attributed to this origin. The need to ensure that every possible precaution is taken is greater today than it ever was. The development of the broiler industry in this country presents new problems in the control of fowl pest, and the swill feeder must continue to exercise the greatest care in sterilizing all potentially dangerous material.

Legislation

The Diseases of Animals Act, 1894 empowered the Board of Agriculture to make Orders prohibiting the importation of animals, carcasses, etc., as deemed expedient to prevent the introduction of disease. Legislation passed through the years in this connection has practically eliminated the possibility of disease being brought into this country by livestock.

A disastrous epidemic of foot-and-mouth disease in 1926 was proved to have originated from fresh pig carcasses from Europe, which contained live virus. Importation from Europe of fresh carcasses and their offals was promptly prohibited. Today the Importation of Carcases and Animal Products Order, 1954 controls the import into Great Britain of meat and animal products which may introduce disease. Conditions designed to minimize the risk are imposed. The Poultry Carcases (Landing) Order, 1955 bans the importation of uncooked poultry carcasses from all countries in which fowl pest is troublesome. The effect of these Orders is to reduce the possibility of infected meat reaching the swill tub.

The handling and preparation of swill was first legislated for in 1927, as a result of the events of 1926 recorded above. There were subsequent variations of the original Order, and in 1947, following demonstration of the fowl pest virus in imported poultry carcasses, its provisions were extended to include poultry. The Diseases of Animals (Waste Food) Order, 1957 is based on all the experience gained from the operation of the earlier Orders and the scientific knowledge accumulated in these years.

Swill feeders have a legal responsibility to take all the precautions described in the Order to prevent the risk of infection. The dangers and possible consequences of any omission have been described earlier in this article, and the moral obligations should be obvious.

Whenever swill is fed the following security measures must be taken and rigidly enforced. The processing plant should be suitably isolated, licensed where necessary and efficiently maintained. Waste foods must be boiled for at least one hour, and there must be no contact between raw swill and the sterilized material, or any other feedingstuffs. No stock of any kind should have contact with raw swill, containers for which should be proof against dogs, cats, birds and vermin—all capable of carrying virus on their feet or bodies to susceptible stock. Containers and vehicles used for the carriage of raw swill must not be used to carry animals or poultry, feedingstuffs for animals or poultry, or anything which might be used in connection with animals or poultry, until the containers and vehicles have been cleansed and disinfected. Ideally, workers handling raw swill who are required to handle livestock should do so only after careful disinfection and a change of overalls.

If swill feeders follow these points strictly, swill will be no danger to either their own or their neighbour's stock, and the utilization of waste foods for conversion into pigmeat will remain a worthwhile contribution to the national economy.

Effects of Cold Storage on Fruit and Vegetables

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Mr. Roach describes the effects of temperature, humidity and CO_2 on the condition of fruit and vegetables in store and after removal from store.

WHEN fruit and vegetable crops are harvested, they continue to live and breathe, kept alive by food stored within them. Eventually they either die, through some functional disorder, as with internal breakdown of apples, or are spoilt by wilting and shrivelling or by rotting by some disease organism. If held in air at room temperatures, fruits ripen rapidly and most vegetables come quickly to the end of their life. At low temperatures, respiration and the chemical changes concerned with their life slow down. Thus the real function of cold storage can be regarded as one of retarding development, but the changes cannot be stopped altogether.

Fruit and vegetables absorb oxygen and give off carbon dioxide in much the same way as when animals breathe; at the same time heat is liberated. Freshly harvested produce may consist of 80–95 per cent water, which in

warm weather contains a considerable amount of "field heat". In cooling, both this and the heat produced by respiration have to be removed. Sometimes produce is pre-cooled to remove field heat rapidly before storage. Thus apples picked in the heat of the day may be left to cool in the open overnight, and put into store when the temperature is lower during the early morning.

Storage life

The storage life of fruits and vegetables is largely dependent on temperature; within limits, the lower the temperature the longer the life. Different kinds of produce vary considerably in the period for which they can be stored and still be marketed in satisfactory condition. Perishable soft fruits such as strawberries, which have a very limited life in warm weather, may be held for two or three days at 35°F. Some varieties of plums and cherries may be stored for one to two weeks at 31–32°F. Most apples grown in America and a few English ones, including Newton Wonder, can safely be stored for long periods at 32°F, and some varieties of pears, such as Conference, can be stored successfully for several months without damage at temperatures as low as 29°F. Many English varieties of apples, however, including Bramley's Seedling and Cox's Orange Pippin, suffer from low temperature breakdown if stored too long at temperatures approaching 32°F, and are best held at 37–40°F. If these varieties are stored at 32°F, low temperature breakdown may develop rapidly during the marketing and distribution of apples which appeared in perfect condition on removal from store.

Most vegetable crops can be held satisfactorily for varying periods at 32°F, but some are injured if stored too long at this temperature. For example, runner beans suffer low temperature injury at 32°F, but may be stored safely for seven to eight days at 38–40°F. The latter temperature can also be used for storing most other vegetables for short periods.

To prolong the storage life of produce it is essential to reduce the temperature as soon as possible after harvesting. Care should be taken to avoid leaving packages of fruit or vegetables out in bright sunshine. If they cannot be put into store straight away they should be put under temporary cover, or at least shaded from direct sun.

Effect of storage on disease organisms

Low temperatures prolong the life of fruit and vegetables by reducing rates of respiration, and also by retarding the activity of fungi and bacteria which cause deterioration and disease in the produce, although the temperatures used do not normally kill the organisms. For example, the growth of the fungus *Botrytis*, which causes rotting of strawberries, is considerably slowed down by holding these fruits at a temperature of 35°F but, on their removal from store to normal room temperatures, the fungus is able to grow fast and may bring about considerable rotting by the time the berries reach the market.

Fruit and vegetables which are damaged in any way, whether by insects, infection by disease or as the result of handling, do not usually store well,

since wounded tissue is more easily invaded by organisms causing rotting. It is important to ensure that, as far as possible, produce intended for storage is free from such damage as broken skins and bruises, and to avoid including any already showing signs of rotting. Containers in which any plant debris is left may support the growth of fungi, which by producing spores may spread decay in stored produce.

The actual stage of maturity for storage is important. Immature produce, especially apples, may be liable to certain disorders and over-mature produce to other types of trouble. Such storage faults become more obvious when the produce is removed from store and the temperature is raised.

Humidity

The removal of heat from stored produce inevitably involves the loss of some water. The cold air leaving the cooling coils can hold more water when it is warmed up in passing over fruits or vegetables and so picks up water, much of which must come from the produce. When the air is again passed over the coils a certain proportion of the water it holds is deposited on them. The greater the difference in temperature between the air and the cooling coils, the more the water is deposited and thus lost from the produce. By the provision of a sufficiently large coil surface and efficient insulation of the store, this temperature difference can be kept to a minimum, and the relative humidity of the air maintained between 85 and 90 per cent or slightly higher. The closer the humidity is kept to the higher figure, the less the loss of water from the produce.

The humidity of stores may sometimes be improved by recirculating the condensate over the coils, by using water atomizers and by ensuring that packages containing fruit and vegetables are not bone dry when put into the store. But it is only possible to maintain a satisfactory humidity level by the correct construction of the store and the provision of sufficient cooling surfaces. The relative humidity has an important bearing on the keeping quality of produce. If it is too low, wilting is likely in most fruits and vegetables; this is not only serious in itself but may also lead to damage and rotting. If it is too high, though in practice it rarely is, it may favour development of certain types of decay. Apple varieties differ in the amount of moisture they lose during storage. Bramley's Seedling may lose about 5 per cent in weight after several months' storage, and the fruit will still appear firm. Worcester Pearmain loses water quicker than Bramley's, and so shrivels faster.

Leafy vegetables can lose moisture very quickly and soon become wilted and unattractive if the humidity level of the store is on the low side, even at temperatures as low as 32°F. Stored cauliflowers may lose one per cent of their weight each week, and loss of weight from stored root crops, such as carrots stored at a temperature of 34°F, may amount to one per cent a month. Wilting of stored fruit and vegetables occurs in stores where air is forced through ducts on to the produce at high speed. Care has to be taken in arranging the stacking of produce near the duct outlets to allow uniform air flow through the stack.

As mentioned earlier, fruits and vegetables use up oxygen and give off carbon dioxide in approximately equal proportions during respiration. Air consists of oxygen and nitrogen in the proportions of 21 : 79, with traces of

water vapour and carbon dioxide and still smaller traces of other substances. As a result of respiration the atmosphere of a closed store will gradually change, tending to contain less oxygen and more carbon dioxide than normal air. With apples and pears, which in their initial days of storage are respiring at a high rate, the accumulation is considerable if the store is gas-tight.

Gas storage

The work of Kidd and West, carried out originally at the Low Temperature Research Station, showed that the presence of carbon dioxide in the atmosphere slowed down the rate of ripening of apples and pears, at any given temperature, to about two-thirds the rate at that temperature in air, the life of the fruit in store being accordingly about half as long again. A specific effect of storage in an atmosphere containing carbon dioxide is to retard the change of ground colour of the fruit from green to yellow, a point of great importance with certain culinary varieties such as Bramley's Seedling. The carbon dioxide also preserves the hardness of the fruit. One of the most important advantages of gas storage, to the distributor and consumer, is the long life of the apples after removal from store. It is of particular value in prolonging the life of apple varieties which cannot be stored at 32°F owing to their susceptibility to low temperature breakdown.

If the accumulation of carbon dioxide in the store is allowed to go on unhindered, it will reach a level which will in time prove lethal to the fruit and, in practice, the percentage is controlled by admitting air from outside. The amount of carbon dioxide allowed before ventilation depends on the variety of apple or pear stored. With Bramley's Seedling and Lord Derby, the store is ventilated to maintain 8–10 per cent carbon dioxide and 13–11 per cent oxygen (the remainder being nitrogen). Other varieties, such as Cox's Orange Pippin, keep best in an atmosphere containing less oxygen than can be obtained by ventilation alone, without there being too much carbon dioxide. For these a store is used fitted with a scrubber, or some other means of removing the excess carbon dioxide. With Cox's Orange Pippin, the most suitable atmosphere contains 5 per cent carbon dioxide and 2½ per cent oxygen.

Gas storage has also been found of value in the refrigerated storage of broccoli and cauliflowers. By storing these at 32–34°F in 10 per cent carbon dioxide, their storage life has been increased to a maximum of about five weeks—about two weeks longer than is possible in air at 32°F. A recent development has been the use of a high concentration of carbon dioxide for the storage of black currants. Storing at 35°F in 50 per cent carbon dioxide for the first week, subsequently reduced to 25 per cent for the rest of the storage period, it has been possible to keep black currants in good condition for processing for about four weeks, with practically no loss of vitamin C. Such a high concentration of carbon dioxide would damage the majority of fruits. It is not possible to produce concentrations of this order by restricted ventilation of the black currants, so that additional carbon dioxide has to be introduced into the store. Twenty-five per cent carbon dioxide has also been found to be of value in the pre-cooling and transport in insulated vans of strawberries and raspberries. The carbon dioxide has a marked effect in retarding the ripening of the berries and in checking the onset of rotting.

Condition of produce after storage

A refrigerated store can be a great asset on a horticultural holding for the temporary storage of all types of produce—over the weekend, for example, or for longer periods—but care has to be taken if the stored produce is to reach the consumer in good condition, and its storage life should never be extended to its limit.

The period for which produce can be stored and remain in satisfactory condition after removal from store varies considerably from one crop to another. Apples are usually in eating condition but have a fair life ahead of them on removal from store. Pears, on the other hand, generally need to be held at room temperature for two to four days before they develop their full flavour, and then have only a comparatively short life before they are out of condition. Strawberries have an even more limited life after storage, and need to be moved quickly to avoid breakdown. Some vegetables, such as winter cabbage and Brussels sprouts, can be stored successfully for several weeks at 32°F and appear in good condition on removal; but with cauliflowers the browned ends of the stalks generally need trimming off, and there is often a certain amount of leaf dropping. Lettuce, which may be held in store for seven days, does not usually stand up so well as the fresh produce and the stalk butts tend to become pinkish brown. Root crops, onions, celery and leeks come out of store in fresh, marketable condition.

Profile

William Cumber, C.B.E.

H. G. SANDERS, M.A., PH.D.

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THERE have been Cumbers at Theale ever since it was the Thiel Hundred, part of Windsor Forest, in the twelfth century. They farmed land in and around where the present village is, and it was as a direct descendant of this long line of farmers that William J. Cumber was born in 1878. His father was not only a farmer; he had a butcher's business as well, and it was to the latter trade that he apprenticed his son. William had three years' training at Guildford, then returned home to take over the management of the butcher's business. But his heart was in farming, and in 1909, on the death of his father, he took over the 150 acres of Haywards Farm. From 1910 to 1914 he farmed another 1,372 acres in partnership, but had to give it up when the estate to which it belonged was sold. By then, however, he had the tenancy of 400 acres at the neighbouring village of Bradfield, and 800 acres at Yatesbury in Wiltshire. The purchase of Beansheaf Farm at Theale in 1918 completed the farming enterprise to make some 1,600 acres, and this William Cumber is still farming, but now in partnership with his son John.

The farms carry some 500 acres of corn each year and are fully equipped

for mechanized harvesting. A large drying and storage building was put up at Beansheaf in 1951. But it is livestock that have always been William Cumber's major interest, and many times has he said that it was livestock that kept him going in the difficult farming days between the wars. He differed from his colleagues on the N.F.U. Council over the Corn Production Act immediately after the first world war; in those days many farmers were still ploughing up to grow more corn, but he was already busy laying land down to grass.

The Shires and the Shorthorns

It is difficult now to imagine a farmer with 72 licensed stallions, but that is the number he had when his Shires were at their peak. All through the 1930s he had around 45 stallions travelling. He was, of course, a great stalwart of the Shire Horse Society. He has been its President, and for many years he was a well-known judge. His show successes have been many, including four female champions at the Shire Show. For lesser mortals it is comforting to think that there are still heights unscaled—William Cumber never won the stallion championship. Now he has only one stallion and eight other horses of all ages, some of which are reputed to do a little work from time to time.

Though the name of Cumber is indissolubly linked with Dairy Shorthorns, in the years before the first world war he had a mixed herd of some 120 cows, mostly non-pedigree Friesians. In 1918 a start was made with Shorthorns, and the pedigree herd which was built up now runs to 125 milking cows. The herd is represented every year in the leading shows and has won many trophies, including five breed championships in the last show season. The culminating point was reached at the 1958 Dairy Show when "Theale Duchess Barrington 2nd" won the Supreme Championship. Enthusiasm was tremendous as the Cumbers, father and son, were drawn round the ring in triumph. But the Shorthorn herd is not kept to provide show winners, nor with the object of topping the milk recording lists. It is very definitely a commercial herd, fed largely on home-grown food and aiming at economic milk production around the 1,000 gallon mark.

Farming opinion in the last few years has swung away from rearing dairy heifers on a high plane, and in this it is supported by a considerable amount of experimental work. The Theale Shorthorn heifer calves have always been brought up in what was regarded as the hard way, but they developed into long-lived cows of great substance. The shelly type has never been favoured, and the policy of developing thick-fleshed animals proved itself when beef became the national need after the war. All the steer calves are reared and usually sold as yearlings, and there is no doubt about their profitability. This is perhaps the keynote of the Theale herd. Outstanding animals prove themselves from time to time against the best the country can provide, but it is the high general level which brings the financial reward.

Flexibility in mixed farming

The glamour of Cumber's farming has come from the Shires and the Shorthorns, but sheep and pigs have not been neglected. Throughout the last fifty

years sheep have been steady, if unspectacular, money-earners (he says that sheep have provided the one branch of his farming activities on which he has never lost money), and now there is a commercial flock of 650 breeding ewes. There is also a herd of 40 sows, half of which are pedigree Large Whites.

The talk nowadays may be all of simplified farming, with the implication that the nearer a farmer gets to mono-culture the better. This finds little acceptance at Theale. William Cumber has achieved a balanced farming system which uses the land fully to produce food for a large number of high quality livestock. There is land to spare for growing the grain which has proved so profitable in these last twenty years, and the system of mixed farming will allow him to swing the weight of his efforts whichever way the economic conditions of the future may require. He is a man who is very receptive to new ideas; for instance, he is eager to co-operate with the veterinarians in field trials of new vaccines and other new methods of disease control. But in fifty years he has gained a vast experience of practical farming and he is unlikely to forget the lessons he learned in more difficult times. His land and his livestock have always been well cared for, and the same is true of his workers. Most of the men who join his staff reckon to stay with him till they retire, and they know that provision will be made for their old age; on the other hand, any bright young man is encouraged and helped to go for training for higher posts.

Tireless public work

Until his son returned from college in 1935, William Cumber had the whole farming responsibility and managed the butcher's business, yet he found time to carry an incredible load of public work. He is still extremely active on local and county bodies and at the national level, but John has taken most of the business weight off his shoulders. William Cumber was chairman of the parish council for over forty years and is still a manager of two village schools. He has been a member of the Berkshire County Council ever since 1922—an alderman for the last thirty years. For seven years he was vice-chairman of the Council and for three years its chairman. His practical common sense, coupled with his ready appreciation of the possibilities of new methods and new ideas, have made him also a valued member of the County A.E.C. in both wars and up to the present day.

During the first war he worked on the livestock side for the Ministry of Food, and was a prominent member of the Council of Agriculture throughout the existence of that august body. In the national field he is widely known as the chairman of the Farmers' Club all through the second war. To be chairman of the Club at all is a considerable honour when duration is limited to one calendar year. But William Cumber's year was 1939, and he carried on the Club (with the help of Mr. E. P. F. Sutton and Mr.—now Sir Richard—Haddon) till the end of 1945. In such troublous times it might have been expected that this Emergency Committee would have been passive caretakers—but not a bit of it. During Cumber's seven years' chairmanship the Club moved to fresh premises and about trebled its membership.

He has always been in demand for committee work because he is so good at it. His very practical outlook does not prevent him from seeing the wider

questions, and no one is less likely to miss the wood for the trees. When deliberations have reached an impasse he produces the commonsense suggestion which is then obvious to all the others, who cannot understand why they did not think of it themselves.

It is not proposed to catalogue all the public bodies which William Cumber has served so effectively, but mention must be made of his Presidency of the Smithfield Club, membership of the Luxmore Committee and governorship of the Royal Veterinary College. The range seems limitless, yet one of his most pleasing thoughts is that he has been a deacon of Theale Congregational Church for over fifty years. And in the multitude of trophies that adorn his sideboard two relatively humble cups are his real pride: one was for a foxhound puppy that his grandfather walked in 1867, and the other for the Heavy Weight race he won in 1912 at the South Berks point-to-point. Honours have also come his way—C.B.E. in 1947 and Honorary Fellowship of the R.A.S.E. in 1955.

Only someone with a happy family life could do all this and succeed in so many fields. Mrs. Cumber, who carries her years just as well as does her husband, was the daughter of Sir Edward Brown, far-famed in the poultry world and organizer of the first World Poultry Congress. Their son and five daughters are all prominent in their own spheres.

William Cumber has indeed made a mark in British farming and yet he has always found time to give the helping hand. Lord Bledisloe, when presenting his portrait at the Farmers' Club, said with true insight that while he may not have been superlative in any one thing, he was a rare example of the yeomen farmers of England.

★ NEXT MONTH ★

Some articles of outstanding interest

THE WOOL WE WANT *by S. R. Blackley*

WIRE FLOORS FOR LAYERS *by David Watkinson*

ELECTRICAL AIDS TO HORTICULTURE *by R. Marshall*

MECHANIZATION OF THE MEDIUM-SIZED ARABLE FARM *by D. B. Wallace*

Maize for Silage in the West Midlands

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Recent work has revealed the high potential of maize as a forage crop. Preliminary trials at Harper Adams College in 1959 resulted in the production of an excellent yield of nutritious silage for feeding to beef cattle, at low cost.

MAIZE is pre-eminent as a silage crop in the U.S.A., and there is renewed interest in growing it for this purpose in Britain. For years a limited acreage has been grown in this country, as succulent green fodder for animals during times of drought and grass shortage, with the old variety White Horsetooth playing a prominent part. The modern hybrid varieties are capable of much higher yields of dry matter per acre under our conditions. Detailed work at the Oxford Agricultural Research Station by Bunting and Blackman[1] and Bunting and Willey[2, 3] has shown that maize can be an excellent silage crop, highly nutritious, heavy yielding, and easy to cut and handle. Our present acreage for this purpose, estimated at about 1,000 acres, is small compared with that in many continental countries, and is likely to be substantially increased, particularly in the drier parts of the country.

A trial carried out in 1958 at Harper Adams College showed that the crop would grow satisfactorily even in an excessively wet season. Subsequently, just over twelve acres of maize was sown in 1959, and data was collected from trials and observations.

Culture

Three main varieties, the early Wisconsin 240, and the medium early Wisconsin 270 and Wisconsin 335A were used, and in addition three American and three continental hybrid varieties were compared in a small area of N.I.A.B. trials. The maize was drilled with a standard multi-purpose drill, in rows 18 inches apart and at a depth of 2 inches, on 21st and 22nd May. The seed rate was 40 lb per acre, and the late arrival of the seed delayed sowing about a fortnight. Earlier sowing would have resulted in a more mature crop at harvest. More important than sowing date, however, is soil temperature, for a mean soil temperature of 50°F or more promotes quick germination and vigorous establishment of seedlings. Germination was rapid, for the crop emerged within a week, and the delayed sowing date gave additional time for weed control.

Fertilizer treatment consisted of 6 cwt of a compound (chemical) fertilizer, plus 3 cwt Nitro-Chalk per acre in the seedbed, supplying 1·18 cwt N, 0·72 cwt P_2O_5, and 1·08 cwt K_2O per acre. Seven acres were top-dressed on 29th June with 4 cwt of Nitro-Chalk per acre, but this resulted in leaf scorch, and no apparent benefit to the crop this season.

No after-cultivations were carried out, nor are they contemplated if chemical weed control proves satisfactory. Apart from the additional cost of

cleaning cultivations, and the likelihood of clashing with seasonal work in the beet crop on arable farms, the relatively shallow, spreading, fibrous root system of the maize plant may be damaged.

The seed was dressed, but rooks were a menace from the time the crop emerged until it reached six inches tall, and great vigilance was needed. Automatic guns, scarecrows, stringing the field, and seed dressings have all been advocated. Despite extensive precautions, one acre of the crop was ruined by rooks, and had to be ploughed out.

A trial area of 1·2 acres was treated with the pre-emergence sprays Simazin and Atrazine, applied five days after drilling the maize. Both chemicals gave good control of annual weeds, and appeared to check couch grass.

The main area was sprayed with 20 oz per acre acid equivalent MCPA at two stages; part at the five-leaf stage and a height of six to nine inches on 19th June (7 acres); and the rest when the crop was twelve to fifteen inches high on 4th July. Both sprayings were carried out under ideal, warm, sunny conditions and gave excellent control of a range of annual and perennial weeds. MCPA spraying caused characteristic rolling of the leaves and distortion of the prop roots in the maize. The area sprayed first recovered slowly, and the leaves unfolded; but the leaves of the plants in the later-sprayed area were still markedly affected at harvest. This spray damage, however, was found to have had no significant effect on the yield of green material at harvest in September.

Development of the crop

Rapid germination under favourable soil temperature conditions was followed by steady growth throughout a period of 15 weeks. During the first 7½ weeks the average rate of growth was about 2½ inches a week, and by 12th July the maize was 20 inches tall. In the second 7½-week period, until 3rd September, growth was very quick—about 10 inches a week. Details of the weather during the season are given in Table 1.

Table 1

Weather in 1959

	Rainfall	Rainfall *per cent of average*	Sunshine *per cent of average*	Mean screen temperature °F	Deviation from normal °F
April	3·40	221	90	48·0	+1·7
May	0·99	53	118	54·0	+2·7
June	1·72	83	116	57·8	+0·7
July	1·31	58	122	62·0	+2·0
August	1·01	37	102	61·9	+2·2
September	0·31	17	128	57·0	+1·3

Except in April, rainfall was considerably below average, but there was more sunshine. Throughout the period the mean screen temperatures were consistently high. These conditions should have favoured the maize crop, for it appeared that moisture never became a limiting factor until the end of August.

Harvesting and silage-making

Harvesting was carried out by an adapted forage harvester, fitted with a maize attachment to guide the stalks into a cutting cylinder. The lacerated crop was then blown into a towed trailer. An important feature of the attachment is the spring-loaded cob-saver, which ensures that any cobs knocked off the stalks are caught and fed into the machine. The lacerated material was then put in a covered silo, with an additive to promote low temperature fermentation. Between two and three acres of the crop was ensiled in this way each day.

The cost of growing and ensiling the crop was estimated at £30–35 an acre, or about £2 per ton of silage.

A summary of the results obtained from randomized 22-yard row samples in the crop, taken on 12th September just before harvesting, is given in Table 2.

Table 2

Yields, plant populations, weight of ears, and height of crop on 12th September, 1959

Variety	Yield per acre *tons*	Plant population *per acre*	Weight of ears *per cent*	Average height *ft*	*in.*
AREA OF HIGH FERTILITY					
W.240	25·49	62,000	33	7	9
W.335A (pre-emergence sprayed)	25·21	55,000	23	9	7
W.335A (sprayed with MCPA)	25·15	49,700	29	8	10
AREA OF MEDIUM FERTILITY					
W.240	19·06	62,000	29	7	1
W.335A	21·81	53,000	28	7	3
W.270	19·88	50,000	33	6	10

The results show that the yields ranged from 20–25 tons an acre of green material. The average dry matter content was about 20 per cent, giving a yield of 4–5 tons dry matter per acre.

The density of plants varied between 10·3 and 12·8 per square yard, and was above the ideal of 9 suggested by Bunting and Willey.[3] Density influences the weight of individual plants, the number of cobs per plant, and the percentage weight of the cobs.

There was little difference between the height of the varieties under conditions of medium fertility but, under high fertility conditions, W.335A was twelve–fifteen inches taller than the earlier variety W.240. In the narrow eighteen-inch rows under conditions of high fertility, plants appeared to have been drawn up and were rather spindly: the cobs formed higher up the stems, and were fewer in number. Under those conditions light intensity seems to limit crop development.

The relationship between variety, plant density, and the number of ears per plant is shown in Table 3 opposite.

Table 3

Variety	Plant population *per acre*	Number of ears per plant
AREA OF HIGH FERTILITY		
W.240	62,000	0·97
W.335A (pre-emergence sprayed)	55,000	0·79
W.335A (sprayed with MCPA)	49,700	1·01
AREA OF MEDIUM FERTILITY		
W.240	62,000	0·81
W.335A	53,000	1·01
W.270	50,000	0·89
Widely-spaced plants in crop		1·80

The higher plant population of W.240 is accounted for by the smaller seed size of this variety. Differences in the numbers of ears per plant are influenced by variety as well as density, but these are not marked within the density range shown, except in the case of the widely-spaced plants. Under the high fertility conditions, where pre-emergence sprays were used, plant growth was rapid and unchecked; the plants grew very tall, and these conditions seemed unfavourable to ear production. Since density has more influence on final yield than row width, and mechanical harvesting is difficult in eighteen-inch rows, row widths of 28–33 inches are suggested. A seed rate of 30–35 lb per acre (depending on seed size) on the wider rows should give a plant density within the desirable range of 40–50,000 plants per acre.

Whilst the number of ears per plant influences the percentage contribution by weight of its most nutritious part, the stage of maturity of the ear at harvesting is important. Earlier sowing and later harvesting would have resulted in a greater contribution by the ears to the total weight of dry matter, and this appears to outweigh losses due to leaf fall and reduced feeding value due to increased fibre content of the stover.

Dry matter, fibre content and maturity

The crop was harvested in mid September, but a small area was left for further observations. A limited number of samples were taken at different stages of maturity of the crop. The dry matter content of the ears increased from about 10 per cent in mid August to between 20 and 25 per cent at harvest on 17th September. By mid October the figure had increased to 35 per cent. The dry matter content of the leaves was between 20 and 30 per cent at harvest, but rose sharply to over 50 per cent following air frosts on 26–27th September. The stems showed least variation in dry matter with advancing maturity, remaining at slightly below 20 per cent from the end of August until the beginning of October. The percentage of crude fibre in the dry matter was estimated at 23 in the leaf and 31 in the stem on 1st October.

Air frosts of 2–3°F on 26th and 27th September resulted in severe scorch, discoloration and dying back of the maize leaves, but the cobs, protected by their leaf sheaths, seemed unaffected. It seems that the last week in September would have been the ideal date for ensilage.

Samples of the lacerated crop taken immediately from the trailer at the

time of harvest gave dry matters ranging from 20 to 25 per cent, with little difference between varieties. The highest dry matter of the ears was shown by W.270, closely followed by W.240, but with W.335A much lower. Thus, under conditions of similar fertility, W.270 was the most promising variety, in terms of yields of dry matter per acre.

I wish to thank the Principal, Mr. W. T. Price, for initiating this work, and for the interest he has shown in it. Also my colleagues on the staff for assisting with sampling, especially Dr. N. K. Jenkins for carrying out the chemical analyses.

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Fatal Accidents in Agriculture, 1959 England and Wales

MACHINERY	
Tractors	
(a) Overturned	32
(b) Falls from	7(2)
(c) Various	7(3)
Implements and machines (including self-propelled)	
(a) Power take-off shaft	1
(b) Various	13(2)
Fixed and portable machinery (including power tools)	2
Lorries and cars	6(5)
Electricity	7
	75(12)
HAND TOOLS	2
ANIMALS	
Bulls	5
Other	2(1)
	7(1)
BLOWS AND WOUNDS	5(2)
FALLS	
From ladders, steps, stairways	3
From platforms, ricks, stacks	—
From vehicles and trailers	10(1)
From other heights	2
Through floors or openings	2
Other falls	3(1)
	20(2)
OTHER CAUSES	
Diseases and poisons	7
Burns and scalds (not involving machinery)	1(1)
MISCELLANEOUS	
(a) Gunshot	4
(b) Lightning	1
(c) Others	1(1)
	14(2)
TOTAL	123(19)

NOTE: Fatal accidents to children under 15 years are in brackets and included in totals.

Use Your Vet

JOHN ANDERSON

Secretary, British Veterinary Association

IN the race for higher production at lower costs, the British farmer has no intention of being left behind. Mere acceptance of the logical sequence of soil in good heart, vigorous crops and healthy livestock is not in itself, however, the complete answer to the challenge. Intensive farming brings its own problems, and it is here that science has helped the farmer. Often, it has enabled him to continue and even extend his operations profitably where, before, the future was bleak. Are these advances being accepted too casually? More important still, are they being used as intelligently as they might be?

Although a large number of farmers rely on the advice given by veterinary surgeons, many are still not sufficiently aware that to maintain health on the farm, they should not rely automatically on a well-stocked "medicine chest". In many cases the use of drugs may be quite unnecessary, and may even be harmful in temporarily masking the root cause of the trouble. The substantial sums of money thus wasted could profitably be used to obtain professional advice.

On the farm, as in the home, some reliable first-aid facilities must be at hand for use in emergency. In the treatment of disease the farmer should consider the alternatives open to him. He may buy and administer a remedy which appears to meet the case. But he should remember that even with the skill and facilities of the trained veterinary surgeon, it is often difficult enough to diagnose accurately and treat promptly to give the animal the best chance of survival and return to productivity. He sometimes forgets, too, that the veterinary surgeon is permitted to hold and use certain valuable but potent drugs which are not otherwise available to the stock owner.

In some Commonwealth countries the farming community is protected by Stock Remedy Regulation Acts, under which no product may be offered for sale for the treatment or prevention of disease in domestic animals unless it has satisfied an official body. Thus the farmer has the benefit of help from his veterinary surgeon and the assurance that any "first aid" or other products for farm use have been approved as suitable for the purposes stated. In the absence of similar protection in Great Britain, he may well doubt the value of some products offered freely for the treatment of a wide variety of conditions. Many of these remedies are extremely costly, and the claims made for them often wildly extravagant. Also they are frequently formulated on the understanding that if the contents do no good, they will certainly do no harm. Deception is carried further when the farmer is assured that by becoming his own veterinarian he is saving money. Many stock owners know to their cost that the outlay on worthless or incorrect medication, added to the loss of time in securing expert advice and attention, can be most expensive.

Valuable livestock should not be exploited in this or any other way. If only a part of the money spent needlessly on medicines was devoted to extending veterinary services on the farm, the farmer would be better off and the whole agricultural economy of the country would be enriched.

Hydrocooling

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Work has been going on at the Ditton Laboratory to solve the problems of hydrocooling in the United Kingdom. American practice is not always a good guide under British conditions.

HYDROCOOLING, the removal of "field heat" from fruits and vegetables by immersion in cold water, has been practised for many years in the U.S.A. The process has been used for asparagus, beans, beetroot, Brussels sprouts, carrots, celery, green onions, Italian sprouting broccoli, peas, radishes and sweet corn; and also for cooling apricots, peaches and cherries before marketing.[1]

In the United Kingdom, a number of hydrocooling plants have been installed by vegetable growers during the past three years. Although the methods of use have been worked out for crops in the U.S.A., they will not necessarily apply under conditions in the United Kingdom. Hence this laboratory has undertaken experimental work and has kept in touch with commercial developments.

Experiments have been carried out to solve problems which have arisen, and this article is an account of information which has been obtained. It includes observations on rates of cooling of greens and spring cabbage, and on rates of warming up at various temperatures, as well as an account of some effects of hydrocooling on these and other vegetables. An account of work on the application of hydrocooling to watercress has already been published.[2]

Hydrocooling plant

Hydrocooling is achieved by bringing the produce into intimate contact with water cooled by crushed ice or mechanical refrigeration. In the U.S.A. crushed ice is frequently used, but in the United Kingdom hydrocoolers are equipped with refrigeration machinery. The produce is cooled either by immersion in circulating water at 32–34°F or by a combination of immersion and spraying. Two types of immersion cooler are illustrated on p. (i) of the art inset. In the first type the produce is lowered mechanically on pallets into a tank of water. In the second, packages of produce are held under water by a slatted wooden conveyor belt, which at the same time carries them from one end of a tank to the other.

Reduction of temperature at harvesting from 65 to 35°F requires the removal of approximately 67,000 B.t.u.s of heat from each ton of produce. Owing to the low rate of heat transfer from produce to air, cooling by circulation of cold air takes up time, and loss of moisture is inevitable. Hydrocooling, on the other hand, is rapid and no moisture is removed from

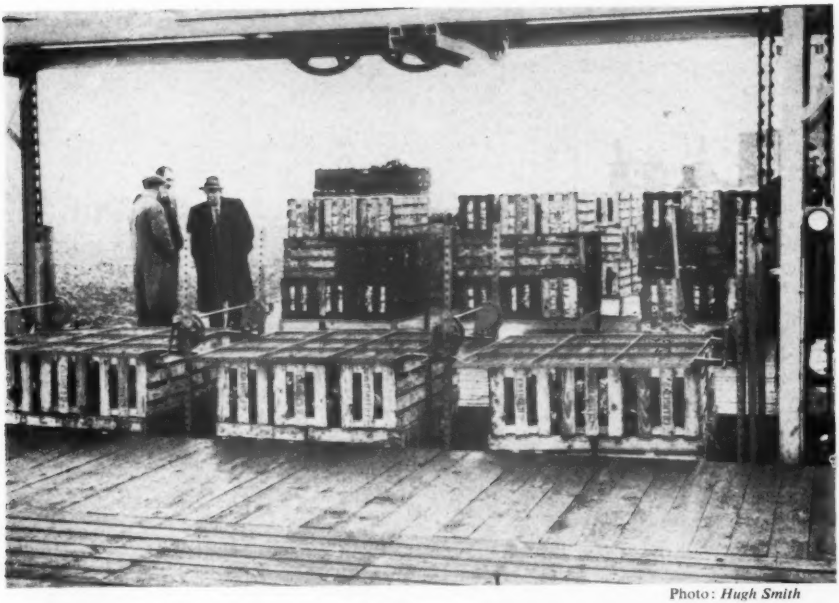
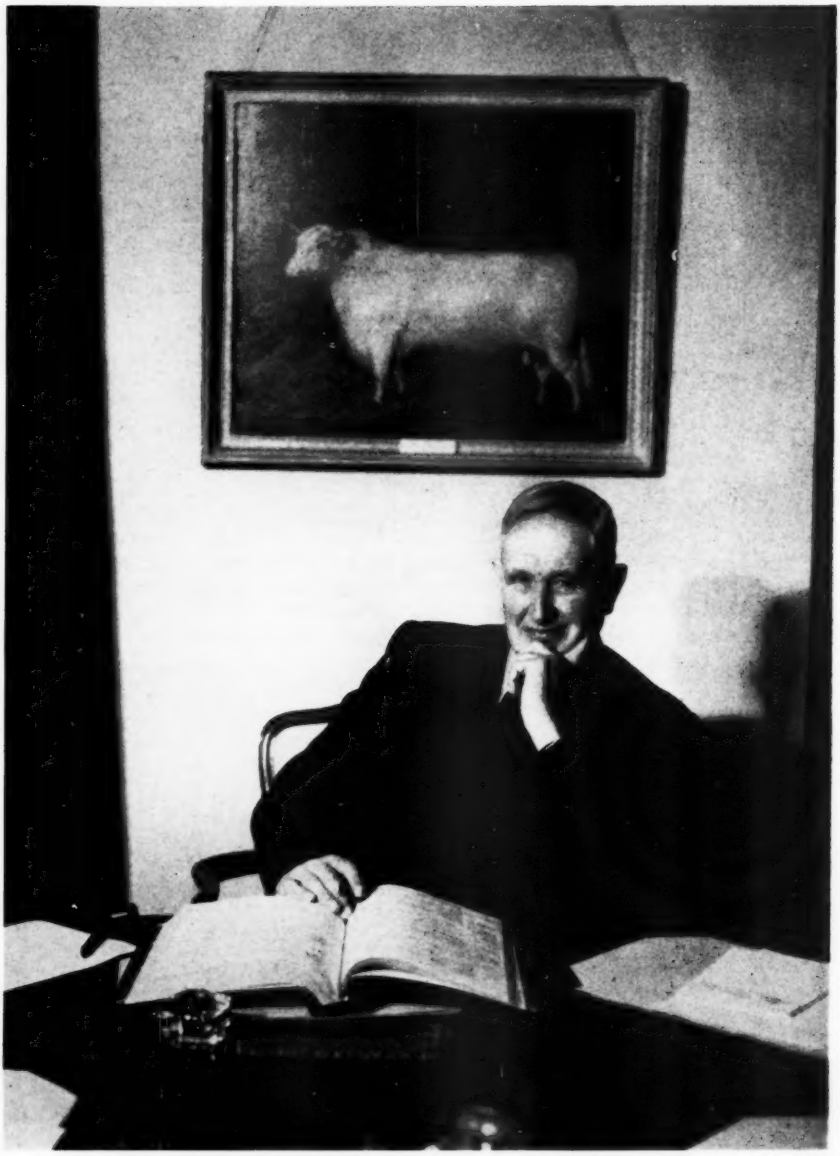


Photo: *Hugh Smith*

Hydrocooling by total immersion. Crates of celery being lowered mechanically into the cooling tank. The crates on pallets in the background are awaiting treatment.

Photo: *Hugh Smith*

A slatted endless wooden conveyor belt keeps crates of cabbage submerged while passing through the tank.



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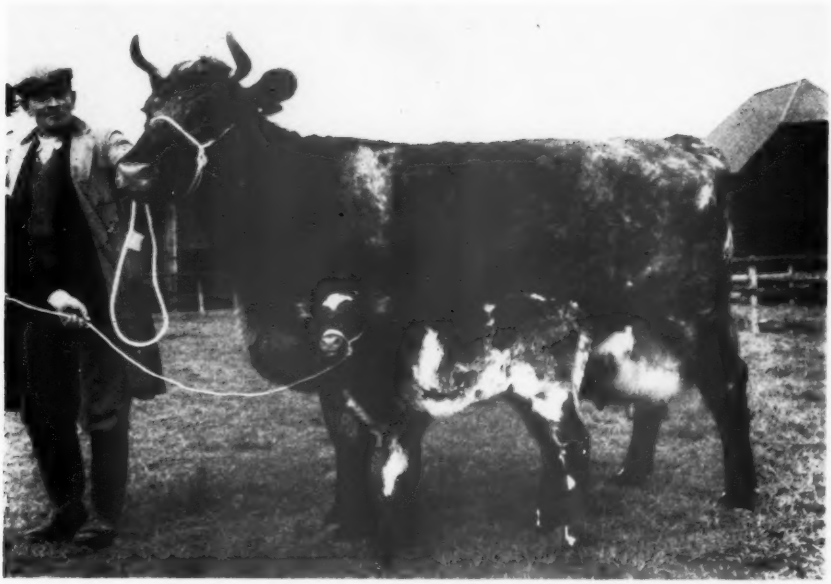
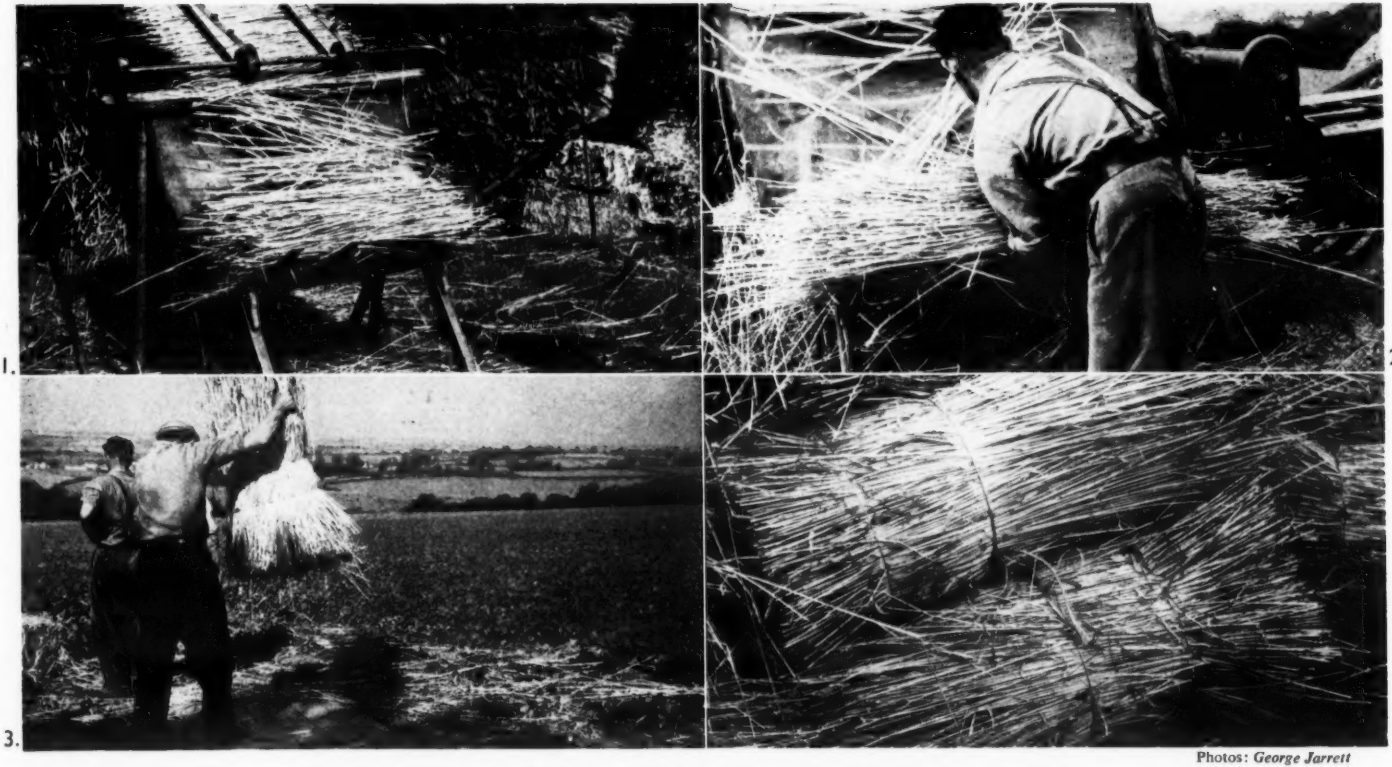


Theale Duchess Barrington 2nd, supreme champion at the 1958 Dairy Show, with her latest calf.

Steady, if unspectacular, money-earners. Part of Mr. Cumber's flock of 650 ewes.



Photos: *George Jarrett*

Wheat for Reed (Article on pp. 85–7). Reed coming off the comber (1) is collected by a tier (2), who will make it into a "nitch" (4). The nitches are double tied with twine and wire, and made tight by drifting (3).

the produce. It has, therefore, considerable advantages for vegetables—particularly those of the leafy sort.

The time taken to cool to 35°F when immersed in water at 32°F varies with the kind of produce. Spring greens, for instance, owing to their open structure, cool more rapidly than a more solid type of cabbage. In tests on cooling rates, we found that if the whole bulk of a spring cabbage, including the stalk, was to be cooled effectively, it needed to be immersed in water at 34°F for 15–18 minutes. Trials were then carried out in a commercial hydrocooler, in which spring cabbage in bags containing approximately 30 lb was conveyed, fully submerged, through a tank of cold water. Fig. 1 shows the temperature of the cabbage in the centre of the bags as it travelled, over a period of 16 minutes, through the tank.*

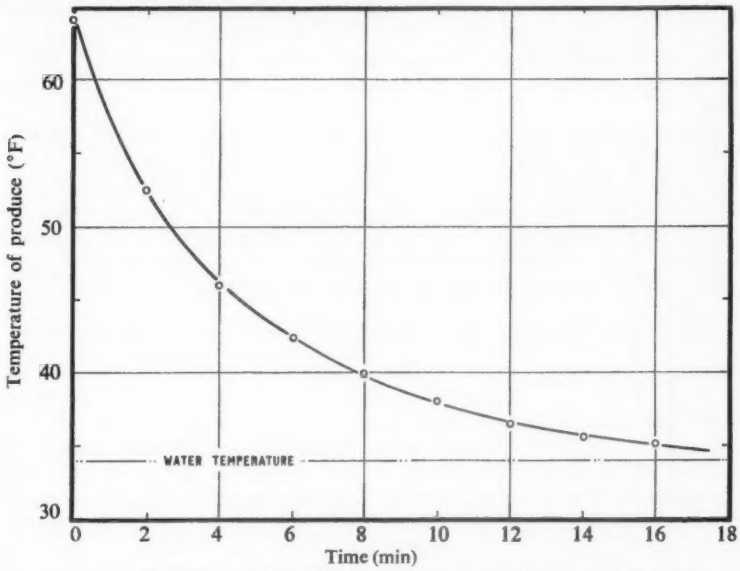


Fig. 1. Temperature of bagged cabbage passing fully submerged through a tank of cold water.

The refrigerating plant must be adequate to perform the very heavy duty placed upon it. A minimum extraction capacity of 67,000 B.t.u.s per hour per ton is necessary. To this must be added the capacity to absorb heat leakage and heat input from the water-circulating pump. There are two methods of providing the required cooling capacity: either a refrigerating unit capable of maintaining the cooling water at 33°F with the maximum throughput of produce at the estimated highest input temperature (e.g., 75°F); or a rather smaller unit operating for 24 hours daily, and building up an ice-bank round the refrigerant coils when produce is not being cooled.†

* A separate cooling trial was carried out at this time in the laboratory wind tunnel. When a bag of cabbage was put in an air stream moving at 12 feet per second at 34°F, cabbage in the centre of the bag took three hours to cool from 68 to 37°F.

† Four cwt of ice will cool about one ton of produce by 30°F.

This second method has the advantage that the refrigerating unit needed is smaller: its disadvantage is that heat transfer from water to refrigerant is probably hindered by the ice layer on the coils.

The plant must be designed for the *maximum* throughput. To plan for 10 tons and then load to 15 tons a day is unlikely to be satisfactory. Overloading may mean that water temperature, instead of remaining steady about 34°F, will rise to 45°F or even higher, within a few hours of the beginning of a run.

If the maximum benefit is to be obtained from cooling, the produce should be kept as cool as is practicable up to the time of sale. Observations have been made on the rate of warming up of hydrocooled produce. This depends upon the temperature of the surrounding air and the rate of production of metabolic heat; and the amount of heat produced is dependent on the kind of produce and its temperature. The higher the temperature, the greater the rate of heat production. At 60°F, cabbage produces between 500–600 B.t.u.s per ton per hour[3]—sufficient to raise the bulk temperature by 0·25°F per hour.

Trials have been undertaken to obtain information on the rate of warming of a stack of bags each containing about thirty pounds of cabbages. In one trial, bags of cabbages were loosely stacked in a barn for 72 hours, during which time the mean external air temperature was 52°F. At the start, the average produce temperature was 42°F, and at the end of the 72-hour period it was 64°F. In a second trial, bags of cabbages were *tightly* stacked, eight layers high, in a room maintained at a constant temperature of 40°F. Fig. 2

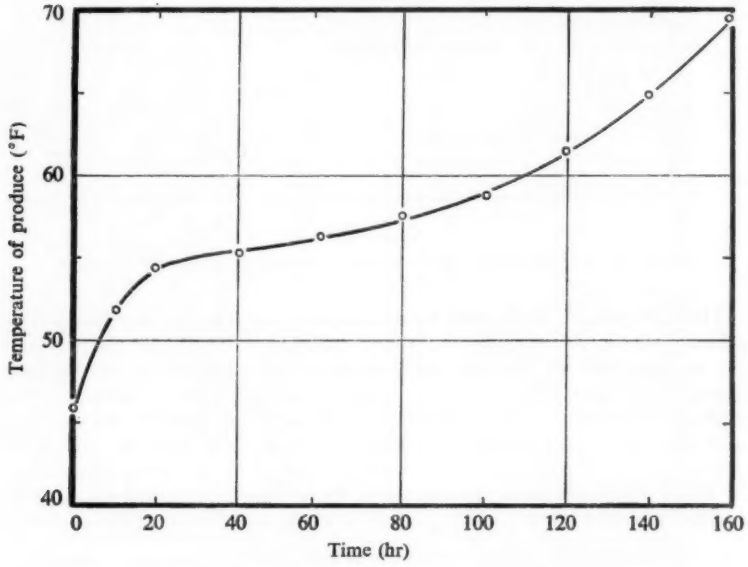


Fig. 2. Changes of temperature in bags of hydrocooled cabbage stacked in a room held at 40°F.

shows the changes of observed temperatures on the centre line of the fourth layer up from the base of the stack. At the end of 24 hours the temperature had reached 54·5°F, and after 160 hours 69·5°F. Calculations based on these tests suggest that if the bags of hydrocooled cabbages had been loaded directly on to a lorry when the air temperature was 65°F, the produce would have reached about 70°F in 24 hours, and about 90°F in 48 hours.

Effects of hydrocooling

Hydrocooling has proved most successful with spring cabbage and spring greens. The additional water taken up by the leaves keeps them crisp for much longer than non-hydrocooled cabbage. The condition of cauliflowers at the wholesale stage is also improved by hydrocooling. If kept for long, subsequently, at ordinary temperatures, there is more "blowing" than with non-hydrocooled cauliflowers. Dark spots on the curds, due to fungi, may appear earlier than with non-hydrocooled produce. Neither of these defects has proved serious under experimental conditions.

Although lettuces are rarely, if ever, hydrocooled in the U.S.A., experimental hydrocooling in U.K. of cabbage lettuce by *immersion* has not proved detrimental. But it is doubtful whether they will stand overhead spraying with ice-water—particularly when they are "soft".

Spring onions have been reported to react unfavourably to hydrocooling, and this has been confirmed by experiment. The outer sheaths become slimy within 48 hours of the onions reaching ordinary temperatures. Runner beans benefit by hydrocooling if they are sold soon after they reach ordinary temperatures, or can be kept cold. They remain wet for a considerable time and, subsequently, if they are kept long at ordinary temperatures, are more likely to decay than beans that have not been hydrocooled.

Experimentally, tomatoes have not reacted favourably to hydrocooling. Although ripening was retarded in proportion to the length of time they could be *kept* cool, within six days of warming up they were found to rot more rapidly than tomatoes that had not been hydrocooled. Some uptake of water was observed, with splitting of the skin round the calyx.

Since it is possible that hydrocooling might be applied to apples, an experiment was carried out to see if the amount of rotting in store was affected. Comparable samples of Cox's Orange Pippin (divided into apparently sound apples and apples damaged by cuts, stem punctures, etc.) were stored at 40°F, either untreated or after hydrocooling to 35°F in water previously used to hydrocool a "wasty" sample. This water carried a liberal suspension of fungal spores. The following amounts of rot were found after four months' storage at 40°F.

	Control *per cent*	Hydrocooled *per cent*
Sound fruits	1	8
Damaged fruits	12	32

This suggests that there is some danger of increasing wastage if apples are hydrocooled.

Hydrocooling of celery is practised on a large scale in East Anglia and Lincolnshire. Since the crop is hydrocooled when the weather is normally

cold, the benefit derived is presumably due to water-uptake, which has been found to amount to as much as 2 per cent by weight.

Provided there were no detrimental effects, hydrocooling of peas would provide a means of efficient cooling in contrast to the circulation of cold air which is often ineffective. Experiments have shown that hydrocooling results in increased rotting unless a low temperature can be maintained afterwards, during the marketing phase. Stored hydrocooled peas deteriorated faster on removal from store at 32–34°F, because they were still wet on removal.

No moisture is lost during hydrocooling; in fact, water is invariably taken up by the produce in the process. Part of this is absorbed into the tissues, and part remains as free water on the surface. The extent of absorption is determined by the nature of the tissues, and also by the extent to which evaporation losses have already occurred.

It is impossible to dry off the free moisture from hydrocooled produce without applying heat, and to do this would destroy the benefit of cooling. Hydrocooled produce is therefore marketed wet, and if subjected to high temperatures or allowed to self-heat, this wetness accelerates the development of rots.

It is evident that, at present, full advantage is not being taken of hydrocooling as a method of improving the market condition of vegetables. To cool, and then take no precautions to delay the warming up of produce, is to waste refrigeration. If hydrocooling is to be much more than a method of "freshening-up" the produce, measures will have to be introduced to protect the latter from absorbing heat from the surrounding air. For short distances, insulated containers should be sufficient. If these cannot be used, a hydrocooled load should be sheeted down immediately after cooling. The covering should be removed when the load reaches the temperature of the surrounding air.

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Wheat for Reed

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Mr. Jarrett believes that much can be done to popularize wheat-growing for reed. The market is there, but the quality of the reed must be improved.

WHEAT is not very widely grown for thatching; it is mainly confined to the south west of England, and to Devon in particular. The large corn growers would not entertain the work involved in growing wheat for reed, but it fits very well into the economy of a smaller farm. There is an unsatisfied demand for really good reed to thatch houses, cottages and inns, and the market is worth catering for. In so doing, however, we must make the reed our main consideration and grain of secondary importance. Recently we have tended to allow the reed to take second place, with the result that a lot of second and third rate material has been produced, which has earned a bad name. The difference between good and poor reed can be as much as fifteen or twenty years of life on a roof.

In growing wheat for reed, therefore, we must forget the modern, high yielding varieties and all our preconceived ideas about high spring nitrogen application; nitrogen is anathema to a thatcher. Forget, too, any thoughts of spring wheat for reed. There has to be a long growing season which only autumn-sown wheat can provide. Spring wheat *can* be combed out for reed, but is worth only about half the money which autumn-sown crops will return.

How do we set about reed making? I work in close conjunction with my local thatcher, and am very grateful for his help and advice. As he says, it will be his reputation which will suffer if he uses a poor reed in his thatching, not the farmer's. My favourite variety is Squarehead's Master, with its fairly long, hollow straw (average about sixty inches). Its red grain and red chaff give that golden harvest colour which used to be such a characteristic of our pre-war cornfields, in comparison with today's predominantly white-chaffed varieties. Victor is another good variety for reed, and is still grown on some farms, but its tillering habit does tend to produce straw slightly bent near the ground before it starts to grow straight. To produce the straightest reed from this variety you must set the binder knife sufficiently high to miss the bent growth. Victor will yield more grain than Squarehead's Master, but the latter is usually regarded as the best reed-producing variety.

Early cultivation and manuring

Where possible I like to double-drill my wheat at the rate of about three bushels per acre, drilling half each way. This gives each plant more room to develop. My thatcher likes a crop which has been grown immediately after a ley, there being something in the ploughed-down humus which seems to add to the quality of the reed. Apart from this, nitrogen is the thatcher's pet aversion, as I have already indicated, and it is no use trying to deceive

him on this point. Wheat which has received spring nitrogen will produce a poorer reed, which he will very soon identify—and reject.

Generally I like to give my wheat half a ton of slag per acre in the seedbed, to provide a good phosphate base. After a ley this may be omitted. I also apply 3–4 cwt per acre of a compound fertilizer with an analysis like 6 per cent N, 15 per cent P_2O_5 and 15 per cent K, again combine drilled half each way. This type of compound will provide just enough nitrogen to give the crop a good start and see it well established before winter sets in, but not enough to do any harm to the final product. After that, no more nitrogen, and no top-dressing in spring with the idea of obtaining a heavier yield of both grain and straw. Some of our north Devon land is not ideal for wheat, and we must not be tempted to take the crop too often in a rotation.

Spring cultivations take the form of the usual harrowing and rolling, after which the crop is left until harvest. To get the best reed, we like to cut the crop just before it is ripe, and let it ripen in the stook. The weather may not always allow us to cut at the ideal time, but that is just one of the normal farming hazards.

It is impossible to use a combine for harvesting: we have to use a binder. The large grain growers can show us some impressive harvest scenes, with several combines in one field, but it is left to us reed producers to provide the old type of harvest picture with its orderly rows of stooks.

As soon as the crop is fit to carry, it goes into the rick. Much as we would like to comb straight from the field to avoid double handling, it is seldom possible to get the extra labour required when everyone else is busy harvesting, and the combing contractors are usually too busy with their combines. The job of combing out reed requires twelve or fourteen men, according to individual conditions, but we usually like to have six or more men tying the reed by hand. This is a highly-skilled job, and the ease of handling the reed for transport to its final destination depends on how well it is done.

Combing

It may be appropriate at this stage to describe the combing operation in more detail. Instead of passing through the normal threshing machine, wheat for reed is passed through a special attachment on top of the drum which, by means of revolving spiked drums, strips the loose flag from the inner part of the straw, which is the actual reed. The spiked drums do this without damaging the straw, and at the same time they thresh out the grain. A characteristic of combed wheat is the presence of a small proportion of cracked grains: apparently this cannot be avoided. A proportion of loose straw, known as combing straw, also comes out and is usually baled. The reed itself comes down over the machine on a special conveyor to a reed rack, where it awaits the men who are tying it into nitches.

A nitch of new reed weighs approximately 30 lb in the autumn, and dries to 28 lb in the spring. Reed can be bought or sold per nitch or by actual weight at so much a ton. Although some reed combers are fitted with automatic tiers, we tie all our nitches by hand, with wire as well as twine. Then they will travel well; this is very important.

Each man takes it in turn to collect the reed from the rack as it comes from the comber and lay it out preparatory to making it into a nitch. When

sufficient has been gathered, it is tied with both wire and twine, and the nitch is drifted or bumped on a wooden base to drive the layers of reed into a tight mass.

When labour is available, the reed may be trimmed and removed from the site as it is being combed, but usually there is only enough labour to complete the combing, leaving trimming and removal until after the main job is done. Sometimes a few nitches are collected straight from the field by someone wanting them for urgent rick thatching or house repairs. My own thatcher takes the whole of my output as he requires it through the year. This year most of it will be used either to re-thatch my own farmhouse or to pay the thatcher in reed for doing the work.

How well does it pay?

What are the economics of growing wheat for reed? We cannot expect such high yields of grain from an older variety like Squarehead's Master as we should from a modern strain; we have to be satisfied with yields around forty to fifty bushels an acre. Yields of reed will be in the region of something like 75–80 nitches—about a ton—per acre; here again individual fields and seasons will produce variations. The reed sells at about 6*s.* 6*d.* to 7*s.* a nitch, the price varying from year to year and according to quality. This means a return of about £24–28 per acre, so that we can reckon on a gross return of £50–60 per acre from grain and reed. To keep down production costs we like to be able to grow enough wheat for a day's combing, as the tiers are paid by the day, and whether they finish at three o'clock or five they will still be paid the same money: 35–40*s.* a day. Seven or eight acres according to yield will provide a good day's combing. The comber itself costs about 30*s.* an hour.

In some parts of the country a solid-walled variety such as Cappelle has been made into reed, although a good Devon thatcher would not think of using it. In the drier parts of the country some of this inferior reed may last longer than it would in the damper west, but any reed in the hands of a good thatcher will produce a good-looking roof—for a time. The real test of reed is the years of good service it will give as a roof. A thatched roof made from good Devon reed should last for twenty-five or thirty years; but if modern varieties or spring wheats are grown, and given too much nitrogen, the life of the thatch can drop to as little as ten years, depending on climate.

How can one judge a sample of reed? Quality is indicated by toughness and, when twisted, good reed will make a rope without fraying. I have already said that in trying to produce quality reed we must forget the grain yield; and in the buying of reed, quality is more important than price. A little extra per nitch can be negligible when the better reed can last fifteen or twenty years longer—and whether the roof lasts ten or thirty years the thatcher will charge just the same for his labour.

At present, Devon reed can vary from good to bad, but the market for first-class material is there. If some attention can be given to producing special varieties of wheat, then the name Devon reed can become synonymous with high quality and long life. This should be every grower's aim.

Hay in a Day?

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There is always room for good quality hay in the average feeding programme. Silage and hay should be complementary rather than competitive, and this indeed is the view which prevails in the feeding policy of the dairy herd at Seale Hayne.

WE know that haymaking is basically an inefficient way of conserving feed because of the high losses of valuable nutrients, particularly carbohydrates and carotene, during curing in the field. Major sources of loss in field curing are respiration, weathering (including leaching), mechanical damage including leaf loss, and—the greatest and most unpredictable of all—unfavourable weather. Any methods of quick haymaking which can reduce these losses, and have the additional advantage in the wetter parts of the country of reducing the risk of the complete loss of a valuable product, are worth investigating.

With heavy crops, it has always been a problem to dry hay in the swath evenly and rapidly. Our climate often makes it difficult to reduce the moisture content to a safe storage level in the swath in under three or four days. Meteorological records of rainfall for the south west over the last ten years, for the months of May to October, show that the total number of dry days is highest for May, which would, therefore, appear to be the best month for haymaking. Furthermore, there are enough single dry days during the haymaking months of May and June to make an appreciable quantity of hay in a day. However, although a "dry day" is one when no reasonable rainfall is recorded, this does not mean that the day is suitable for drying hay in the swath. Rate of drying in the field depends on air humidity, wind velocity and air temperature, all of which are outside the farmer's control. He can, however, vary the swath condition. The objects of the work during the summer of 1959 have been to see to what extent various mechanical treatments would accelerate rate of drying in the swath regardless of method of disposal, and in conjunction with local weather forecasts to evolve techniques of using these treatments for the field curing of hay, or partial field wilting for barn hay drying.

Hay crusher

The College was fortunate in borrowing during the summer an American hay crusher, or "crimper". This is a power-driven machine consisting basically of two fluted metal rollers 6 feet 1½ inches long, factory set one above the other, the small lower one of 4 inches diameter driving the upper roller of 7½ inches diameter. The working height of the lower roller is controlled by lift rods operating on the pair of land wheels. Material is picked up and

discharged by the rollers, and strikes an adjustable baffle whose position determines the condition of the windrow.

The machine was first used during June. A heavy hay crop, predominantly of cocksfoot, timothy and meadow fescue, was cut with a 5-feet mower, and at the same time crimping was started. With a working width of 6 feet some difficulty was experienced in following the mower, due to the absence of windrow guards, and some poaching occurred from preceding and succeeding swaths, which resulted in the rollers wrapping on several occasions. By raising the baffle judiciously some of the wrapping could be avoided. A tractor with "live" p.t.o. would have been an advantage, and if a mid-mounted mower had been available, a tractor of adequate power would have managed both operations at the same time. The crop was crimped again after 1½ hours. The resulting windrows were turned into tight swaths for the night, tedded early the following morning, and windrowed once more before baling in the afternoon some 39 hours after cutting.

A further cut was crimped only once, and this was gathered 42 hours after cutting.

Condition of windrow

An examination of the windrow revealed several interesting features. Firstly, the machine appeared to leave it fluffy and light, with stems upwards, allowing maximum circulation of air, and secondly the windrow on the ground appeared to be left more evenly than its condition directly after mowing. This enabled an evenly dried windrow to be produced with little evidence of wet, poorly cured patches. Because of the even drying of the conditioned windrows, following machinery dealt with the swaths without difficulty. The pick-up baler was able to produce bales of consistent length and density, which is a vital feature of bales destined for a hay drier.[1]

A closer examination of the grasses revealed that the stems had been crushed at regular intervals along their lengths and that the leaves bore bruise marks. Little leaf loss due to shatter was seen in the field.

Forage harvester

Since the introduction of the flail forage harvester into this country in 1956, there has been an increasing interest in the potential of this machine, not only for silage-making but for haymaking, sugar beet top harvesting, straw disposal, reclamation work and even litter collection and verge trimming.

From time to time various reports have appeared in the farming press of hay made successfully with a forage harvester within 48 hours, and even within 24 hours, of cutting. As the College farm already had available a fully offset flail type forage harvester, it was decided to examine its potential for haymaking. This machine has a power-driven rotor, bearing thirty self-sharpening swinging flails with a cutting width of sixty inches, designed to cut, chop, lacerate and load herbage in one operation.

It was thought that for successful haymaking the rotor speed should be reduced and the laceration plate removed, to reduce the degree of laceration and chopping and leave the herbage long yet bruised. A special reduction pulley was obtained from the importers and fitted. The discharge chute was

removed to enable the conditioned herbage to be spread evenly over the ground instead of in a windrow, and allow its maximum exposure to the drying potential of the atmosphere. It was hoped that these modifications would also reduce the power demands of the forage harvester, as considerable power is absorbed in lifting grass up the discharge chute.[2] The importers kindly agreed to prepare a special hood for the machine to blow back the herbage and allow it to settle on the ground.

Field work

The machine was first used for haymaking in a permanent pasture on 9th June. On the day after cutting, the conditioned herbage was tedded by taking the machine over the field again with the tractor operating in a higher gear with a low throttle setting. Little further damage appeared to be done to the herbage—the machine acting like a vacuum cleaner and blowing the material back on to the wet stubble. The third day the crop was windrowed, but because parts of the field dried slowly—the air was moist and cold with appreciable cloud overhead—the crop was not baled until the following day, 72 hours after cutting.

It was recognized, after early tedding attempts with the forage harvester, that better wilting could be obtained by windrowing the conditioned herbage as soon as it was dry on top. This allowed the stubble to dry before the material was moved further.

A second attempt with the forage harvester was made on the 15th June. The crop was about 25 cwt/acre of a new ley consisting of cocksfoot, timothy and meadow fescue at the early flowering stage, and ideal for cutting. The forage harvester had little difficulty in dealing with it, despite stones and boulders on the surface of the ground, and approximately nine acres were cut in four hours. The air was dry and warm, with appreciable sunshine, so drying was rapid and it was not necessary to use the forage harvester to ted. The conditioned herbage was fit for baling the following day, 31 hours after cutting.

An examination of the product revealed that the herbage had been lacerated, and chopped or broken more than was required. The spider-wheel type of swath turner and side-delivery rake proved to be suitable for windrowing, or turning the conditioned herbage, however. The swaths at baling were gathered satisfactorily by the baler retracting tine pick-up, although some loss of grass was inevitable. At the time this loss was not considered sufficient to side-rake any further.

In Great Britain, the day-time rate of wilting of long herbage appears to be about 1–2 per cent per hour.[3, 4, 5] The advantage of crushing on rate of wilting has already been shown by others. One worker[7] concludes that wilting occurs during the nine-hour period early morning to mid afternoon.

During the summer of 1959, which favoured rapid drying, 35·3 per cent moisture was lost in nine hours with the hay crusher. This is approximately 4 per cent per hour for twice crimped hay. Where the crop was crimped only once, 24·8 per cent was lost in eleven hours, at a rate of 2¼ per cent an hour. Forage harvester conditioned herbage lost 19 per cent of moisture during one four-hour period late morning to mid afternoon, which is approximately 5 per cent per hour. On two further occasions 21 per cent moisture was lost

over seven hours, and again over a 6½-hour period 26 per cent moisture was lost at a rate of approximately 4 per cent an hour.

In considering these figures account must be taken of weather conditions prevailing at the time. Full meteorological records were kept during the summer. For example, the rate of 5 per cent moisture loss per hour was recorded under good drying conditions, whereas earlier rates of 3 per cent per hour were recorded during poor conditions with a high relative humidity.

Potential of forage harvester

Experimental plots comparing forage harvester and crimped herbage with long unconditioned material have already established that, under good drying conditions, particularly high wilting rates are possible with the forage harvester—as high as 5 per cent an hour over the first day. Over a normal nine-hour wilting period this could give a moisture loss of 40–50 per cent a day under good weather conditions, and therefore makes feasible "hay in a day" without artificial drying. The flail type forage harvester will pick up partially wilted grass and therefore can be used as a tedder. It shows distinct possibilities as a multi-purpose hay machine. But further work is necessary to find the lowest moisture levels at which the machine can safely be used as a tedder, for a loss of crop due to shatter of up to 36 per cent has been recorded.

Use of the forage harvester and hay crusher during the favourable summer of 1959 has provoked many queries from local farmers. For example, what wilting rates are likely under less favourable weather conditions, and with young leafy material, which is essential for the production of a high quality product? What effect does rain have on bruised herbage? Again there is evidence that, in wet weather, serious leaching losses of extruded plant juices will occur,[6] and that the crop becomes more difficult to handle, with consequently slower drying.

It is hoped that experimental work being conducted at the National Institute of Agricultural Engineering and at the N.A.A.S. experimental husbandry farms, as well as at Seale Hayne College, will answer some of these problems.

I wish to express my thanks to the Principal and Governors of the College for providing facilities to carry out this work, and to J. B. Paterson, Esq., for his encouragement in planning this work.

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Baling Green Hay

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Farmers who find silage-making inconvenient, like Mr. P. Murray of Gloucester, will be interested in his method of drying grass in the field. It gives him good hay quickly, and is largely independent of bad weather.

IF good hay was a certainty, there would be no need for silage. Mr. P. Murray of Painswick Lodge, Gloucester, believes that he has removed the "if" from haymaking by developing his own system of baling green hay and drying it in the field. Elsewhere, to avoid loss due to the weather there has been a swing to silage-making, helped by improved feeding and cheaper forage harvesting techniques.

The virtues of grass silage are too well known to need discussion here, but even the most ardent advocate would admit that silage is not always the complete answer. Over the past few years, quick haymaking techniques have been given appreciable publicity as an alternative. The hay is tedded and turned, then perched on racks or placed on rails to dry. There are also elaborate barn hay drying outfits, which require a lot of hard work or a great volume of air, or both, to achieve the object—good hay.

Mr. Murray found it inconvenient to make silage. In his search for a method of making good hay he decided to base the field work round the tedder. Baling makes for easy handling; and he was determined not to double handle bales in a barn, so he decided to dry his hay in the field, when it was cut. Only hay fit to store is brought in. The drying outfit is moved from field to field as each crop of grass is making.

Large volume of warm air essential

The whole principle of his system is to blow a *large* volume of slightly warm air through the stacked bales. If insufficient air is blown through the bales, the whole operation fails.

The engine used is a 30 h.p. air-cooled diesel, mounted on rubber wheels, and driving an axial flow fan. This fan is surrounded by a housing to collect some heat from the engine, and it has an air displacement of 30,000–40,000 cubic feet per minute at 1½–3½ inches water gauge. Although the temperature can be raised 4–6°F by using the engine heat, Mr. Murray feels that it is of prime importance to push through a large volume of air. This is blown into a hollow wooden box which forms the mouth of the tunnel at the inlet end. The tunnel is continued by rectangular frames made of 1½-inch angle-irons four bales high. Two 3 × 4-inch timbers are laid along the top between the frames; across these at intervals of one foot are laid 6-feet lengths of piping or poles, and the stack of bales is built along this tunnel. For each length of a bale on the tunnel, 60 bales go into the stack, and 130 are needed to build the ends. To calculate the length of a stack of 550 bales, subtract

the number at the ends (130 bales), and divide the remainder by 60: $550-130=420$, and $\frac{420}{60}=7$. The tunnel should be seven bales in length. A stack could be made to hold 400–1,200 bales, but 800 is about the best size. It has proved possible, under good operating conditions, to dry an 800-bale stack to below 20 per cent m.c. within six days when the crop was baled at a rather high initial moisture content. The fan is usually run for about 14 hours daily. On average, about eighteen tons of dried hay can be made per week.

This year the fuel cost little more than the string for the bales; fuel consumption is usually 1½ gallons of diesel oil an hour, or 5–6 gallons per dry ton.

Ten to twelve acres of a two-ton crop should be cut in the morning, and the swaths are tedded as they are cut. Next morning the field is again tedded and two rows put into one. It is important to remove as much moisture as possible in the field before baling. With drying weather the hay is baled in the afternoon, using a sledge to leave small stacks of bales. Bales weighing 60–85 lb should not lose shape in drying, and they should not be so tight that a hand cannot be pushed into them.

The tractor which has completed the tedding is fitted with a front-mounted buck-rake and dumps the small stack of bales at the stack site. When baling is completed the three men stack the bales; they can build a stack of 800 in three hours. From cutting to stacking takes about thirty-six hours, but in bad weather the hay has to be moved daily for four days or so.

The drier is used at the stack until the outside bales are nearly dry, at which time the next field is prepared for baling. Any outside bales which are too wet for storage are carried to the next stack.

The bales are removed to the hay shed as soon as possible, but if there is any delay they may be sheeted. A sheet is not used during drying unless rain is imminent, as in Mr. Murray's view the effects of condensation are greater than those of rain.

Because the night air is relatively humid, making the drying less effective, the fan is not usually run at night, although it is sometimes necessary to run it slowly to prevent heating in the stack. Under most conditions a temperature rise of 4–6°F is adequate to reduce moisture to 17 per cent but, to raise the temperature, part of the fan is blanked off. Average midday humidity for the months of May, June and July can vary from 64 per cent in a good season to 72 in a poor one; a temperature rise of only 2°F will make up for this difference.

In addition to 150 tons of hay, the drier is able to dry grass seed and also 30 tons of bagged corn at a time, or 200 tons in the season, round the tunnel. The outfit costs about £540, and as it can dry a number of lots of hay the capital cost is spread accordingly. If we assume a life of ten years, the capital cost per ton of hay would be about 7*s*., and for 150 tons hay and 100 tons corn 4*s*. a ton. The results of the analysis, on p. 94, illustrate the quality of hay produced.

The first four samples were made in 1958, a poor haymaking season. Sample number 4 lay in windrows for ten days, and was tedded each time the weather allowed. The remarks of the analyst bring out that the samples are without exception well-made hay. Dried hay is always palatable, and

retains a lot of leaf. These samples had a particularly good colour, texture and smell, and are superior to hay made by almost any other outdoor method.

Report on hay samples

	Analysis of material as received				
1958	Crude protein *per cent*	Crude fibre *per cent*	Estimated starch equivalent *per cent*	Estimated protein equivalent *per cent*	
Seeds (second cut)	10·2	28·5	34	5·2	Good sample.
Ley	10·1	22·1	28	5·0	Quite leafy, considerable amount of clover, green, good harvest condition.
Timothy/fescue	7·4	29·7	34	3·2	Quite leafy, some clover, green, good harvest conditions. Dried from 30 per cent moisture.
Timothy/fescue	10·9	33·9	29	55	Slightly stemmy; a little clover, fair colour. This field was weathered in windrows for ten days—note the high percentage of fibre. Dried from 35 per cent moisture.
1959					
Lucerne	15·3	29·2	30	8·7	The energy value is lower than that of the "seeds" hay.
Old ley	10·2	24·2	38	5·2	Good colour and smell; leafy, with fairly good clover content.
Seeds (fescue, ryegrass and clover)	11·1	32·2	31	5·8	Well cured leafy hay with good clover content. Cut when past its best owing to dry weather.
Cocksfoot ley	9·0	31·2	31	4·4	Good leafy sample, with fair clover content.
Lucerne (second cut)	18·2	27·3	31	10·8	Very good analysis.

Mobile drying enables full use to be made of men and machines and has the advantage of being a quick way of making good quality hay with a measure of independence of bad weather. In a season like 1959, good hay could be made by traditional methods. The drier allows the whole crop to be uniform in spite of the most difficult weather. Much of the success of the system is due to the capacity of the fan, which enables it to dry large batches.

There is no doubt that the method has a great deal to be said in its favour, and will compare with any other means to produce high quality hay, either in capital cost, running cost, or—not least—in its great flexibility.

Farming Cameo: Series 2

25. The Ely District

JOHN RITCHIE
District Advisory Officer

ELY is probably best known for its magnificent cathedral. Few visitors realize that the surrounding fenland, which some 300 years ago was a boggy waste, now contains some of the most productive land in the country. The Ely district comprises that part of the Isle of Ely lying south-east of the Bedford rivers, two straight channels engineered by those pioneers of fen drainage, the fifth Earl of Bedford and Cornelius Vermuyden. It covers 72,000 acres, and contains 1,201 farms—619 over 15 acres and 582 of smaller size.

The bulk of the peat fen area is below sea level. Owing to drainage and cultivation the peat has gradually wasted away, and before major drainage operations were begun in the seventeenth century, the surface was probably sixteen feet or more above its present level. Much of the land is still shrinking at the rate of one-half to one inch a year, and there are few areas left with a depth of more than four or five feet of peat. The more usual depth is fifteen or eighteen inches.

Drainage is of paramount importance, and water from the network of farm dykes must be pumped up into the embanked river channels. Since the early days of draining the fenman has had vivid memories of the fens being "drowned" from time to time, when the river banks failed to contain the upland waters. The new Flood Protection Scheme is designed to overcome this problem once and for all, and it is interesting that part of the scheme follows an idea put forward by Vermuyden in the seventeenth century.

Immediately beneath the peat, and above the Jurassic clays, an alluvial deposit of silty clay is normally found, but sand and gravel also occur in places. The clay surface is usually irregular, and clay blisters are a common sight when some soils have been ploughed. These peaty soils show great variation in depth, texture, reaction and general behaviour.

This is an area of intensive arable cropping, as would be expected with a combination of deep, fertile soils and a suitable climate. Wheat, potatoes and sugar beet are the principal crops, and insufficient regard to crop rotation in the past has led to eelworm problems. However, beet eelworm is being kept in check through the Beet Eelworm Order; and although potato root eelworm is a serious pest, farmers are learning how to live with it. Celery is an important crop too—some 25 per cent of the country's output is produced in the district around Littleport and 70 per cent is grown within fifteen miles of the town. Chicory (for blending with coffee), onions, parsnips, carrots, peas and herbage seed—principally Italian ryegrass—are also grown to a limited extent.

With sugar beet playing such an important part in the farming economy, it is not surprising that Ely should possess its own beet sugar factory. Built

in 1925, it is now equipped to deal with up to 4,000 tons of beet daily. The by-products of the factory, particularly beet pulp and sludge lime, are valued highly by local farmers. Sludge lime has a special value for neutralizing acidity in peaty soils where the condition known as "drumminess" also exists.

As regards livestock, winter fattening of cattle is traditional in the fens, and there are still a number of farms buying in stores for fattening despite the warnings of the economists. More farmers are turning to rearing their own calves, and labour-saving arrangements for feeding cattle in yards are coming into use.

Blowing is a phenomenon experienced on the lighter peat soils, and in some years it can be a serious problem. Soil containing seed, young plants and fertilizer is blown from the fields in great clouds. Dykes may be filled with the dust, and established crops are frequently damaged by the force of the blown particles. In a bad year, crops may have to be drilled two or three times before a satisfactory plant is obtained. The traditional remedy for reducing the risk of blowing and to improve peat soils generally is "claying". Originally done laboriously by hand—digging down to the clay subsoil and throwing the clay up to the surface for mixing with the peat—the job is now mechanized, and dragline excavators are used very successfully.

Trace element deficiencies occur, and the chief problem here is lack of available manganese. However, routine spraying of crops with manganese readily overcomes the trouble.

Rising above the peat fens are a number of "islands", some quite small but others forming ridges several miles long, which branch out from the middle of the district where the City of Ely stands. It was on the principal island at Ely that Hereward the Wake successfully avoided capture by William the Conqueror for so long.

The highlands reach a maximum of 120 feet above sea level, but they are mostly between the 50 and 100 feet contours. The soils are mainly boulder clay, with some gault clay and Lower Greensand.

Farming here is mainly arable, and is influenced by the intensive crop production on the adjoining fens. Even some of the very heavy and difficult soils are kept in arable, and sugar beet and sometimes potatoes are grown, in addition to wheat and barley. Much of this land is badly drained, but more and more tile and mole-cum-tile schemes are being put in hand.

Some dairying is carried on, and there is a definite trend towards loose housing of cattle. Silage is not very popular, but with a greater interest in cheaper and labour-saving methods of management it is likely to play a bigger part in the future.

The frost-free Greensand slopes in the south provide scope for the fruit grower, and plums, gages, apples and pears are grown, together with a small acreage of black currants and gooseberries.

A characteristic feature of the district is that towns and villages are located on the highland, and building development often stops abruptly at the edge of the high ground. Shrinkage of the peat has presented building problems, and fen farm buildings are traditionally poor but, with the aid of modern building techniques and the Farm Improvement Scheme, many first-rate buildings are springing up in the fens today.

At the Farmers' Club

Practical Progeny and Performance Testing of Sheep and Cattle for Meat

So much emphasis has been placed recently on progeny and performance testing as research tools that their practical application to meat production on the farm tends to be overlooked. At the Farmers' Club on 13th April, Mr. John Young and Mr. Oscar Colburn described how systematic recording and testing can be used by cattle and sheep breeders to help meet present-day commercial requirements.

Although competition in the show ring will remain a great incentive to breed improvement, undue attention to breed correctness has left an unsatisfied demand for bulls strong in characters of utility, said Mr. Young. "When only a notional 25 per cent of the apparent excellence of a beast is due to heredity, and only a sample half of that is contributed by each parent, something more than observation by eye and guidance of ancestry is required to uncover this small vital fraction by the average breeder." Recording would enable a far greater number of breeders to follow a positive breeding policy and to attain higher standards.

Mr. Young described his own system of performance recording as "a fact-finding exercise" used to supplement traditional methods of selection. He provides as near as practicable a level plane of environment for all breeding stock, to eliminate the influence of feeding and management on genetic factors that are not highly heritable.

The cows all calve between September and March and are fed alike. The calves suckle their dams for 7–8 months, and are weighed at birth and at 7 months; these weights give an accurate index of the maternal ability of the cow. "I think it is important", he said, "that any young bull intended for service in the herd should have a good weaning weight, which is only possible if his mother is a reasonable milker. He is then likely to make his contribution to the milking propensities of the heifer replacements he sires."

The cows are listed in order of merit, according to their calves' weaning weights. The 1958 and 1959 placings varied very little, confirming American experience that rearing performances are generally repeated, making it safe to cull after two poor efforts. Heifer calves are bunched at weaning, fed the same rations, and at 18 months weighed, scored for conformation, and turned in with the bull. The aim is to retain size with quality.

The tendency in our beef breeds is to get smaller and more compact animals in the quest for early maturity and to cater for the export market but, said Mr. Young, "I like to breed for some size and substance, for not all buyers of bulls like small stock, particularly for mating to Friesians". As a check, all cows are weight recorded at maturity, after their third calving.

Any bull calf from a second calver that gains less than 2 lb daily at weaning is castrated. Those to be reared for service are weighed at 8 months and

then once monthly to 14 months, when conformation is checked and recorded. They are fed to appetite twice a day on hay and concentrates, and get half an hour's daily exercise. Thus, for each bull, the records show birth weight, weight at 14 months, and average daily gain both on the dam and on feed test. A bull's performance under these conditions is a sound guide to his inherent commercial qualities.

In the search for more efficient and cheaper forms of fat lamb production, attention so far has been focused mainly on the various aspects of management, said Mr. Colburn, but if profits are to be maintained, more productive strains of sheep are likely to be required. "I believe that breeding systems based on progeny and performance testing are weapons for the specialist, and of little use to the commercial sheep farmer," he said. But I also believe that simple systems of flock recording can be most valuable, if carried out in full knowledge and understanding of the fact that they are an extremely useful aid to selection and management but are unlikely to lead to any real genetic improvement."

Flock recording can provide a check on pre-natal feeding, growth rates of lambs, fleece weights, and various aspects of health and disease. It can show which ewes are consistently good producers, help to make culling more accurate, and lead to steady improvement within the flock of strongly heritable characters such as growth rate and fleece quality. But for weakly inherited characters such as prolificacy, milking capacity and carcass quality, improvement will probably depend on proper progeny testing in large flocks, or on comparisons, under controlled conditions of management and environment, of the performance of half-sisters of various rams. For improving growth rate, which is highly heritable, performance testing is the more appropriate.

In practice, only a handful of flocks within each breed have any real influence on the genetic structure of the breed as a whole, so future development depends on the adoption in these key flocks of breeding systems more critical and accurate than those in general use now.

In Mr. Colburn's self-contained Clun Forest flock, the aim is to improve prolificacy, milk capacity and growth rate. Fifty-two ewe lambs are brought in each year and their performance recorded for five years. Only those that have reared nine lambs are retained. These, which must be above-average milk producers, are used for ram breeding. Each year four rams are progeny tested over a three-year period. They are mated to ewes in their third, fourth and fifth lactation to see which ram transmits the highest growth rate. Thirteen daughters of each test ram make up the year's flock replacements. A record of the number of lambs they produce, plus the lamb's growth rates, indicates the prolificacy and milk capacity transmitted by the rams. After repeating this test for a second year it is usually easy to assess the merits of the sires. The best is mated to the elite flock of proven ewes to produce the next batch of ram lambs.

It takes three years to test each group of rams in this way, and as each group is compared within itself, three distinct blood lines are maintained within the flock. "We are triple crossing lines of sheep which are being progeny tested at each stage for the possession and transmission of desirable qualities."

Sylvia Laverton

THE MINISTRY'S PUBLICATIONS

Since the list published in the April 1960 number of AGRICULTURE (p. 46), the following publications have been issued.

MAJOR PUBLICATIONS

Copies are obtainable from Government Bookshops or through any bookseller at the price quoted.

Co-operative Farms and Smallholdings with Centralised Services in Wales. Report and Accounts of the Welsh Land Settlement Society for the Year 1958–59 (*New*) 2*s.* 6*d.* (by post 2*s.* 8*d.*)

Smallholdings organised on the basis of Centralised Services. Report and Accounts of the Land Settlement Association for the Year 1958–59 (*New*) 2*s.* 6*d.* (by post 2*s.* 8*d.*)

BULLETINS

No. 22. Soil Sterilization (*Revised*) 4*s.* 0*d.* (by post 4*s.* 4*d.*)

This new edition (5th) covers both steam and soil methods of sterilization, the effects they have and the treatment of the soil after it has been sterilized. There is also a special chapter on the layout of soil sheds. Fully illustrated with photographs and text drawings.

No. 71. Soils and Manures for Vegetables (*Revised*) 5*s.* 0*d.* (by post 5*s.* 5*d.*)

This new edition (3rd) describes all types of soils suitable for vegetables, together with appropriate fertilizers and manures, and also fundamental work on mineral nutrients and deficiencies. It is primarily intended for the commercial grower, but the final chapter deals with the manuring of private gardens and allotments.

LEAFLETS

Up to six single copies of Advisory Leaflets may be obtained free on application to the Ministry (Publications), Ruskin Avenue, Kew, Surrey. Copies beyond this limit must be purchased from Government Bookshops, price 3d. (5d. by post).

ADVISORY LEAFLETS

No. 10. Fruit Tree Spider Mite (*Revised*)
No. 85. Onion Downy Mildew (*Revised*)
No. 115. Slugs and Snails (*Revised*)
No. 271. Potato and Tomato Blight (*Revised*)
No. 479. The Coypu (*New*)

FIXED EQUIPMENT OF THE FARM LEAFLET

No. 44. Design of Horticultural Packing Sheds (*New*) 6*d.* (by post 8*d.*)

FREE ISSUES

Obtainable only from the Ministry (Publications), Ruskin Avenue, Kew, Surrey.

GROWMORE LEAFLET

No. 44. Mole Drainage for Heavy Land (*Revised*)

UNNUMBERED LEAFLET

Watch for Warbles (*Revised*)

In Brief

THE FLEECE AND THE FLESH

Sheep are the focal point of the Ministry's exhibit at this year's Bath and West. It will show sheep husbandry as a profitable modern enterprise, if geared accurately to the needs of the market. Profit to the farmer lies in giving the customer what he wants—lean joints for the housewife and clean, dry wool for the manufacturer.

In fat lamb production, the prolificacy of the ewe is probably one of the most important single factors, so flock replacements and rams for tupping should be chosen from the offspring of prolific ewes of the right type. Thus good management—flushing at tupping time, steaming-up before lambing and good feeding—will ensure that none of their inherited potential is lost. Lambs depend for the first six weeks on the ewes' milk for growth and then, with fresh bite by creep grazing, you should get well-finished lambs at twelve to fourteen weeks.

Remember too that inadequate nutrition can affect the quality of the fleece. Black and kempy fibre in the wool are inherited characters, so breeding stock must be selected carefully.

After lavishing care on the wool crop for a whole year, it doesn't make sense to be careless about staining and dirtying the wool before sending it to market.

These and other aspects of making your sheep pay will be demonstrated on the Ministry's exhibit at Bath (Avenue H, Stand No. 395). Make a note of the dates —1st–4th June.

NORFOLK AGRICULTURAL STATION

Mr. Frank Rayns, who has been Director of the Norfolk Agricultural Station at Sprowston since 1925, is retiring next October. He has thus been associated with agriculture in Norfolk for thirty-five years, and will be especially remembered for his work on fenland reclamation during the war and for his authoritative work on sugar beet.

Mr. Rayns will be succeeded as Director by Mr. A. C. Owers, who is at present Farm Director of the Ministry's Experimental Husbandry Farms at Terrington St. Clement and Kirton.

FARM BUILDINGS OF THE FUTURE

Following closely the changes in husbandry practice, a quiet revolution in farm buildings design has been going on since the end of the war. In particular, with increased mechanization, larger buildings and greater space for working are required, and in the last twenty years the framed building of Dutch barn type has come to the fore as the basis for most farm buildings. Such a building, having its roof supported independently of the walls, is much more adaptable than the traditional type, where alterations to walls are always expensive and sometimes impracticable. But even these buildings have their disadvantages.

Changes in the feeding methods of cattle housed in yards have brought changes in the layout of buildings and yards, so that cattle may have access to food and yet be safely under control. The most notable change is the growing practice of relying upon wooden feed mangers to form the boundaries of the cattle yards. By chaining these mangers together, an effective barrier is formed, and when the time comes to remove the manure the mangers are taken away, leaving a long face at which mechanical loaders can work speedily.

One of the major changes is the introduction of insulation materials in live-

stock buildings. Unheard of in this country twenty years ago, it is now so common place that most farmers everywhere think automatically of insulation in their livestock buildings.

But what of the future? The developments of the last decade are only a beginning. There is widespread awareness that we need fresh thinking about our buildings and many bodies are actively engaged in considering the many problems involved.

If we can take the present pattern as a pointer, then the buildings of the future are likely to follow the framed building in type but not in design. The uprights of a framed building can interfere with the adaptability and free movement particularly in implement sheds and open-fronted livestock buildings. The design of the future must reduce to a minimum the interference with adaptability and free movement, and we may see buildings with roofs supported along their central line, leaving the sides and the greater part of the ends free from obstruction. Such buildings will be even more adaptable than the present Dutch barn type of structure with far less interference with free movement. This type of building, commonly called the "umbrella" building, is very adaptable. It can provide housing for dairy cows and other cattle: implements, hay and straw are easily stored and well protected in it, and it is ideal for grain drying and storage. It is well suited to mechanical feeding of livestock of which we are sure to see more in the future.

Future building methods will undoubtedly make greater use of prefabricated units, made in a factory and assembled quickly on the farm. We see this already in the framed structure, and prefabricated walling and internal fittings could provide a stock of units from which any kind of farm building could be erected quickly, and perhaps at a lower cost.

Materials of the future? There is nothing at present to indicate any major departure from the traditional materials of timber, brick, steel and concrete, which have stood the test of time. Nevertheless, the chemical industry is producing thermoplastic materials of some strength, and we may well see their appearance in farm buildings as cladding and dividing partitions. Other well-established materials (for example, aluminium, copper and zinc) may become cheap enough to use in farm buildings of the future.

C. Robinson

ERNEST SALMON MEMORIAL LIBRARY AT WYE: AN APPEAL

Ernest Stanley Salmon, Emeritus Professor of Mycology, University of London, and Fellow of Wye College, who died last year at the age of 88, is justly regarded as the father of English hop research.

His attention was first drawn to this interesting crop, to which he devoted a lifetime of effort, in his early days at Wye—where he went in 1906. The search for a disease-resistant hop led him to undertake an extensive and highly successful programme of breeding which resulted in the famous Wye varieties, now grown in Europe, the U.S.A. and the Commonwealth. His work had a profound effect on the hop industry and also established the principles on which current hop breeding at Wye is based, the aims being to combine the best flavour and brewing quality with disease resistance and suitability to machine picking. Salmon was the first to bring a true scientific approach to bear on the problems of hop production; he was in many ways a remarkable man, besides being a distinguished scientist.

The College believes that there should be some permanent memorial to his life's work, and it is thought that this might fittingly take the form of a research library at the College, to be named after him. A suitable building, already earmarked for additional library facilities at the College, could be reserved for this purpose.

About £5,000 will be needed to furnish and equip this library, and an appeal for such a fund has recently been launched. The contribution which such a library would give not only to hop research, to which Professor Salmon gave so much, but to the general research work of the College is clearly important, and it is hoped, therefore, that there will be a generous response to the appeal.

Contributions should be sent to the Secretary, Wye College, near Ashford, Kent.

POTATO PREFERENCES

We grow more Majestics than any other variety of potato, according to acreage statistics prepared by the Potato Marketing Board. They occupy nearly 60 per cent of the area sown to potatoes in England and Wales. King Edward is next in line, taking about a quarter of the acreage, and the rest are almost nowhere. These figures, set out more fully in the table below, interestingly reflect the taste of the English and Welsh consumer, as well as, of course, the predilection of the English farmer for a high-yielding variety. But turning to Scotland, we can see that several factors, including the Scots housewife's preference for potatoes with more distinct flavours, give a very different cropping pattern.

Maincrop potato planting

Percentage of acreage planted under certain varieties during 1959

	England and Wales	Scotland
	per cent	*per cent*
Arran Banner	1·5	0·8
Arran Peak	1·9	0·5
Dr. McIntosh	3·7	2·0
Golden Wonder	—	2·6
Kerr's Pink	0·1	25·0
Redskin	3·1	20·1
King Edward	24·4	11·0
Majestic	59·4	33·7
Record	1·5	1·1
Other varieties	4·4	3·2
	100·0	100·0

Only one-third of the Scottish potato acreage is down to Majestics and only 11 per cent to King Edward: other varieties, like Kerr's Pink and Redskin, almost unknown south of the border, take up a much higher proportion; while Golden Wonder also accounts for a small share.

FEEDING OF ANTIBIOTICS TO FARM ANIMALS

The Agricultural and Medical Research Councils have set up a Joint Committee to examine the possible consequences of the feeding of antibiotics to farm animals and to consider whether this use constitutes any danger to human or animal health. The Committee will make such recommendations to the two Councils as may be thought necessary and its report will be made available through the Councils to the Ministers concerned.

Lord Netherthorpe, a member of the Agricultural Research Council, has accepted an invitation to act as Chairman, and Professor A. A. Miles, C.B.E., the Director of the Lister Institute of Preventive Medicine, has agreed to take the

chair of a scientific sub-committee which will examine the evidence in detail and place its findings before the main Committee.

Apart from medical and veterinary scientists, the membership of the Committee includes farmers and experts in animal nutrition.

INSECTS, BIRDS AND MAN

"There is little concrete evidence to justify the popular belief that birds are effective in keeping down harmful insects," said John Treherne in a recent B.B.C. broadcast. There are 5,000 or so species of pest insects which compete with man for his food and living space on this planet. In Britain alone, to take just one example from a recent survey, the minute frit fly causes yearly damage to cereal crops equivalent to putting 300,000 acres out of cultivation. It has been calculated that one-third of all the food grown throughout the world is either eaten or spoiled by insects.

"It is certainly true that individual birds of various species consume large numbers of insects, especially when they are rearing their young," said Mr. Treherne. "One pair of tits, for example, has been estimated to take 7–8,000 insects (chiefly caterpillars) during a period of three weeks. A single pair of starlings has been recorded as bringing 27,000 insects to the nest during the fledgling period." But what proportion of the insects taken were actually pests? and what fraction of the total population of the pest did these represent? Observations on starlings taking leatherjackets in Holland and Scotland do not justify putting the figure higher than 1–2 per cent.

Another side to the question, said Mr. Treherne, is that in general "insect populations seem to be kept down to a large extent by factors such as disease and various parasites. With the cabbage white butterfly it was found that the majority of a given batch of caterpillars died of disease, or were eventually killed by small wasps, whose larvae develop inside the bodies of the living caterpillars. In fact only about 6 per cent of the caterpillars survived to enter the chrysalis stage. Of these many were killed by other parasites, but about two-thirds of the remainder were eaten by birds—mainly species of titmice. In this case, although the birds accounted for only about 4 per cent of the original population of this pest, they could have been performing a valuable service, because without their predation the subsequent population of the insect might have been several times larger than it actually was.

"It seems, then, that the actual proportion of harmful insects taken by a single species of bird may be rather small, but when it occurs at a critical stage in the life history of the insect—as with the titmice feeding on adult female winter moths or on the chrysalids of the cabbage white butterfly—then the predation might be of some benefit in reducing pest populations."

AVOIDING SPRAY DRIFT

Spray drift can cause costly damage, particularly when selective weed-killers (for example, those containing MCPA and 2,4-D) are allowed to drift on to susceptible crops such as sugar beet and horticultural crops (especially tomatoes under glass). Risk of drift can be greatly reduced if the following simple precautions are followed: don't spray in windy weather, keep the spray boom as low as possible, use high volume sprays at low pressure, and, if possible, use an efficient boom shield.

Ask for a copy of the Ministry's leaflet *Spray Drift Damage to Crops*, from any of the Ministry's local offices or from the Ministry (Publications), Ruskin Avenue, Kew, Surrey.

Book Reviews

North England. (Regions of the British Isles.) A. E. SMAILES. Nelson. 50*s*.

Professor Smailes has set a very high standard for the new series of regional geographies covering the British Isles. Although intended for the university student and grammar school teacher, this book should give the general reader both pleasure and information about an area which, apart from the Lake District, has been unaccountably neglected. The text is free from unnecessary terminology and it may be read as a whole or in parts.

In the first half of the book the region as a whole is dealt with in terms of its physical background and the sequence of human development. Then follow descriptions of the major sub-divisions of the area, differentiated on the basis of industrial and rural occupations. The author is at his best when dealing with the evolution of the settlements and the industrial areas.

There is no special chapter on farming, but reference is made to it in all parts of the book. In all his regional syntheses the author attempts to assess the importance of economic, historical and social factors, as well as the influence of climate, soil and slope upon modern agricultural patterns. This is well brought out when discussing the negative effects of raiding in the Border dales, and the improvement of the holdings by farmer-miners in the lead dales. Scenic and social aspects of forestry are also discussed, with special reference to the Lake District and Border forests. In the Border area the more intensive land use, and greater opportunities for employment in forestry, are considered to outweigh the benefits to be derived from the marginal land which has been taken over.

The publishers must also be congratulated upon the general format and the lavish provision of maps and plates. The latter are collected into a supplement, which admirably illustrates, by means of ground and oblique aerial photographs, old prints and town plans, the dominant cultural and physical elements of the northern landscape. A well-printed, coloured relief map at the back opens out so that it may be consulted when reading any part of the book. For the specialist there is a detailed bibliography arranged by chapters, though the non-alphabetical order of the authors is inconvenient. Unfortunately the quality of the layout, combined with modern printing costs, may have forced the price beyond the reach of students, who are most likely to benefit from the possession of this excellent book.

G.T.W.

Agricultural Arbitrations (2nd Edition). R. CHARLES WALMSLEY. Estates Gazette. 30*s*.

The first edition of this book quickly established itself as a standard work. Since its appearance in 1952, much has happened to justify a second and revised edition.

Several interesting and relevant cases have been decided in the courts, and in 1952, 1955 and 1959 one-day conferences of agricultural arbitrators were held, at which points of practice were discussed, and papers read by lawyers with special experience of agricultural law. These meetings were most valuable; they have contributed knowledge and experience used in the revision of the text.

An extract from an address by Mr. R. E. Megarry, Q.C., to the 1955 conference is given in Appendix B. This discusses the meaning of the statutory definition of a rent properly payable, and is worth careful study because the Agriculture Act, 1958, stipulates that such a rent shall be based on the open market rent, and by this means it was hoped to improve the level of farm rents. Many people consider that the Act is, in fact, having the desired effect and that the new definition of rent has been of positive help. Mr. Walmsley's chapter on "Rental Arbitration" has been rewritten, and is very well done.

"Costs" has also been rewritten, and must be a particularly useful chapter. It includes some paragraphs on the position where an arbitrator is appointed and then,

either because the parties settle their differences or he is found to have no jurisdiction, the arbitrator has only to determine how costs—including his own remuneration—shall be paid. The chapter closes with some remarks on the amount of an arbitrator's fees, and points out that these will vary with his standing and the time spent on the case.

Although an arbitrator carries a good deal of responsibility, disputes referred to him are usually well within his professional competence, and fees and costs should not normally be so high as to deter parties in dispute from resorting to this old and well-tried method of resolving differences.

R.G.A.L.

Intensive Gardening. R. DALZIEL O'BRIEN. Faber and Faber. 21*s*.

Far fewer "compost" books would ever see daylight if it were not for the enthusiasm of Richard de la Mare, the chairman of Fabers, who takes such a great interest in the organic movement. Here is a book that will horrify some, and delight others! It certainly has a very practical approach, and the author is not afraid to go into details—which so many other books on the subject skate over. As an example, I would instance the instructions given for the use of the "scrapper" (onion hoe) which are, undoubtedly, illuminating to beginners, but would be regarded as rather overdone by the "old hands".

One has got to accept the author's "no digging" ideas as being practical—to her —even though the sowing dates given are, in some cases, rather dictatorial to the average gardener. The general crop instructions for the management of the Dutch light frames are good, clear and workable, and for the first time, as far as I am aware, an author has really tackled motion study as it affects market gardening. Here the book rises to heights unknown in the other chapters. The detail is first class, and it shows that the author has really done the work again and again, and has therefore discovered how to get the maximum results with the minimum of work.

This is a practical, provocative, personal book, and the photographs are certainly outstanding.

W.E.S-C.

Profitable Pig Farming. GEOFFREY JOHNSON. Dairy Farmer Books. 25*s*.

Mr. Johnson's central theme is that "pig farming is very susceptible to detail and super efficiency". It is quite evident that his eminent success as a pig farmer can be ascribed to a very critical approach to an enterprise that can be subjected to what he terms "conveyor-belt principles".

The chapter relating to "Organizational Problems", in which the author deals in detail with the need for the effective use of available accommodation to get the maximum potential throughput of pigs, should certainly cause many pigmen to review their methods. The subsequent chapters dealing with the management of breeding stock, the computation of rations and feeding of baconers, written in the same practical style, contain a wealth of useful tips.

However, in view of the comparative ease with which farmers can nowadays get expert advice on matters of detail, the extensive reference to artificial insemination and eradication of virus pneumonia, although these are very important recent developments, is rather out of tone with the rest of the book. The final chapter dealing with certain disease problems, intermixed with "Hints and Tips", seems to be something of an afterthought, and is not well thought out.

Animal breeding scientists would take Mr. Johnson to task for his comments on selection methods. Though he rightly lists prolificacy, milking capacity of sows, length, grading and growth rate as the major criteria on which selection should be based, he goes on to say that ". . . it is necessary to breed for these factors to some extent singly and separately . . .".

Nutritionists, too, will find some anomalies: for example, though the virtues of ground wheat are justifiably extolled, the recommendation that barley and maize should be viewed with considerable caution is difficult to understand. There is also a singular disregard of modern experimental work concerning the amino-acid deficiencies of certain protein foodstuffs of vegetable origin, which explains their nutritional inadequacies in practical diets. These, among other topics, make it clear that there is still ample scope for evolving better methods of getting results of research investigations across to the practising farmer.

J.T.M.

Dictionary of Agriculture: German-English-French-Spanish. G. HAENSCH and G. HABERKAMP. Crosby Lockwood. 85*s*.

Looking over the fence is no longer sufficient for good farming nowadays—we must look also across the Channel. The wider, international circulation of foreign journals and reports is furthering this broader outlook on agricultural progress, and here is a dictionary calculated to help it. This is the first comprehensive multilingual dictionary in the main European tongues covering the whole field of agriculture since Bezemer's work of 1934. A number of glossaries useful to subject specialists have appeared in the last decade in narrower fields (horticulture, soils, etc.), and now this work combines the advantages of the specialized glossary and the polyglot dictionary.

The main arrangement is a systematic order of subjects: economics and sociology, processing agricultural products, soils, crops, horticulture, animal breeding, buildings, machinery and so on. An alphabetical index of terms for each of the four languages serves as a key to the classified section, and quickly finds a specific word in any one language and its synonyms in all the others.

A number of agricultural specialists and linguists have collaborated to compile this work of some 35,000 references. It should be most useful to all who seek to read widely in European (or Latin-American) literature, and to those who are closely involved in European agriculture—as many are in these days of the common market.

F.C.H.

The Bovine Species. T. BONADONNA. Progresso Zootechnico, Milan. *L*.8,500.

This large volume, which is in Italian, contains some interesting features on the various breeds of European cattle and some breeds of zebus and buffaloes. It deals with the animals in their native countries, and also gives an account of them in the countries to which they have been exported. It is no exaggeration to call it a mine of information about cattle.

The book is well illustrated, and the photographs of typical animals of a breed show the differences in type which have been evolved in the new environments. For example, for the Friesian there are photographs from Holland, Germany, Britain, U.S.A., Canada, Italy, France and Argentina.

Official production records are shown for each country, together with references to publications about the breed. For many of the beef breeds, average weights at different ages and body measurements are given, as well as the numbers that have won the championships at Smithfield and Chicago. Statistics quoted include the production and consumption of milk and meat, and the numbers of cattle in different continents and countries from prewar to 1956.

The information has been compiled from many sources, a list of which is given at the end of each chapter. Included are such varied items as percentage and yields of cows milk-recorded in Denmark since 1903; history and early pedigrees of the Shorthorn, Aberdeen-Angus and other breeds; average weights of many breeds at different ages; breed standards; differences in composition of the milk of cattle, zebus and buffaloes, and milk yields of different grades of Jersey and Red Sindhi crosses.

J.H.

Modern Nursery Practice. Cable Press. 12*s*. 6*d*.

Nine authors have contributed to this very readable book, which is divided into three sections. The first two parts deal with the skills and requirements of nursery businesses in the true sense—the propagation and sale of young plants of all kinds—while the other is largely concerned with crops grown under glass, and with fruits or flowers as the end products. In all sections, emphasis is laid on the need for both nursery staffs and employers to combine plantsmanship with business acumen in order to achieve economic success as an industry.

In the first section, covering the propagation and sale of perennial and alpine plants, Alan Bloom addresses, in particular, the younger members and new entrants to the industry. This does not lessen the value of these pages to the "old hands"; they will find much food for thought and suggestions which, if applied, might enhance the profitability of their own businesses.

The same can be said of Section II, where G. A. S. Brooks deals with the

raising and sale of trees and shrubs. Both authors are to be commended for the way in which they get down to the brass tacks and fundamentals of nursery work while preserving a readable and refreshing approach.

A complete chapter is devoted to propagation techniques which are still in the development stage, and a review of recent experimental work in this connection is given. One omission of note is the lack of any reference to the propagation of strawberries, a subject where methods have changed in recent times, and the stock plant supply position has also been altered by the formation of the Nuclear Stock Association.

The third section, dealing with glasshouse crops, is the work of seven authors, and will be of particular appeal to market growers. In the space available it would be impossible to deal fully with all the cultural details of the eight crops or groups of crops covered, but it can be said that many of the economic and production problems facing growers at this present difficult time are discussed in a very helpful, and often thought-provoking, way.

R.G.

Breeding Field Crops. J. M. POELHMAN. Henry Holt, New York. $8.50.

Four main objectives have been considered in the organization and writing of this book, which is primarily for use in the introductory course in crop breeding taken by agronomy students in American universities. These objectives are to review the essential features of reproduction and the basic principles of genetics, and relate them to plant-breeding procedures; acquaint students with the established methods and techniques of plant breeding; relate breeding procedures to specific crops; and present a fairly comprehensive picture of immediate problems which breeders are attempting to solve.

The first five chapters, which discuss principles and general problems in plant breeding, could be read with advantage by all students of agriculture. The chapters on breeding wheat, oats, barley, rice, flax, tobacco, soybeans, corn (maize), sorghum, cotton, sugar beet and forage crops are unlikely to interest British students, either because they deal with crops of which they have no knowledge or because the treatment is too concerned with American problems and varieties. A final chapter discusses problems of increasing, distributing, and certifying seed of new and improved varieties.

Despite the strong American bias, which extends to the list of references and suggestions for further reading, the book should find its way into libraries in this country, particularly as it is so carefully and strikingly produced. The photographs are excellent, and the diagrams and line drawings are outstanding, both in their quality and usefulness.

H.W.H.

The Lily Year Book, 1960. The Royal Horticultural Society. 15*s*.

Any work published by The Royal Horticultural Society is worth reading, and this applies especially to *The Lily Year Book, 1960*. The six colour plates are very beautiful indeed, and the black and white illustrations are also good. Work in Japan, Australia, New Zealand, Holland, Canada and the United States is adequately covered.

Undoubtedly the highlight of the book is the report on lily research by Dr. S. L. Emsweller, the Principal Horticulturist of the United States Department of Agriculture. His views on lily breeding will be much respected, and it is encouraging to know that the tetraploids of *Lilium longiflorum* are proving to be the most desirable garden lilies. They are very sturdy, have white trumpets and strong, thick petals. Dr. Emsweller reports that the breeding of lilies on the tetraploid level holds the greatest promise for increasing the number of desirable cultivars for our gardens.

Mr. K. Wada, a leading nurseryman in his own country, came all the way from Japan to speak on lilies. His report and the coloured slides, two of which are reproduced in the book, are well worth studying. He keeps his lilies free from virus infection by growing them, if necessary, in cages made either of bronze or plastic 30–40 mesh screen, and also by occasionally spraying with insecticides.

Space does not allow adequate reference to Dr. D. W. Doak's wonderful work in New Zealand, or the report on the growing of fritillaries since 1933.

This is a book to study, a book to discuss, and one which every lover of the Lilium family must have.

W.E.S-C.

The Farmer in a Technological Age. (The George Scott Robertson Memorial Lecture, 1959.) ROBERT RAE. Queen's University of Belfast. 2*s.* 6*d.*

This was a felicitous choice of speaker. Sir Robert is so aptly fitted, both by long and intimate friendship and by a happy similarity of career, to perpetuate the memory of one who like himself devoted the greater part of his lifetime to bettering the farming of an adopted country. They had shared so much—from "digs" at Chelmsford, when they were colleagues on the staff of the East Anglian Institute of Agriculture, to Professorships at Queen's University and the joint Directorship of the Hillsborough Agricultural Research Institute. Even when their paths later diverged, they led eventually to similar places—Scott Robertson to the Secretaryship of the Northern Ireland Ministry of Agriculture; Robert Rae to the Directorship of the National Agricultural Advisory Service. And both served long spells in Washington, D.C.

Sir Robert has used this occasion to survey the rapid growth of agricultural education in recent decades, and to look at what this offers to the farmer of today, in terms of research, advice, and the technical education of his children and his workers. He finds that the response of the farming community in England and Wales to the available technical educational facilities does not compare well with the attitude shown in other industries. Our farmers' investment in youth—ultimately the most rewarding of all—is still too restricted; too many places at the Farm Institutes are not taken up. A highly technological industry covering 250,000 self-employed persons and 433,000 regular workers should not rest content with a technical education for fewer than 30,000.

To the celebrated accusation of an overlong time lag between the findings of research and their application to commercial farming, Sir Robert applies a needed corrective. The lag is usually exaggerated, and in general it is not found between the research station and farming, but between the top level farmers and the rest.

Another corrective concerns the current fashionable enthusiasm for work study, which Sir Robert rightly sees, not as an end in itself, but as an additional tool in the farm management kit.

He disclaims any attempt to peer into the future, but the questions raised by his comments on the probable developments in advisory services are charged with the weight of his experience. Are we approaching the time when the personal request visits of the advisory officer may have to be curtailed? Are the swiftly growing demands on the analytical facilities of the advisory service laboratories, now almost embarrassingly heavy, a proper function of agricultural extension, however worthwhile and necessary? Farming in this technological age is demanding more precision, more measurement, even its own instrumentation. Is the satisfaction of this need a responsibility of Government or of the industry itself?

To raise such questions is a worthy memorial to a man who spent much of his official life finding answers to many which were similarly pertinent at his time.

G.G.

Books Received

The Living House. George Ordish. Rupert Hart-Davis. 25*s.*

Annual Report of the Plant Breeding Institute, Cambridge, 1958–59. 5*s.*

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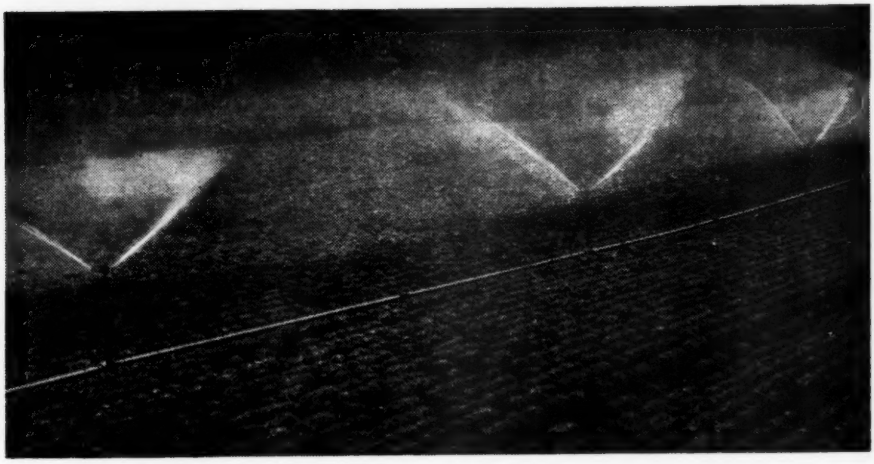

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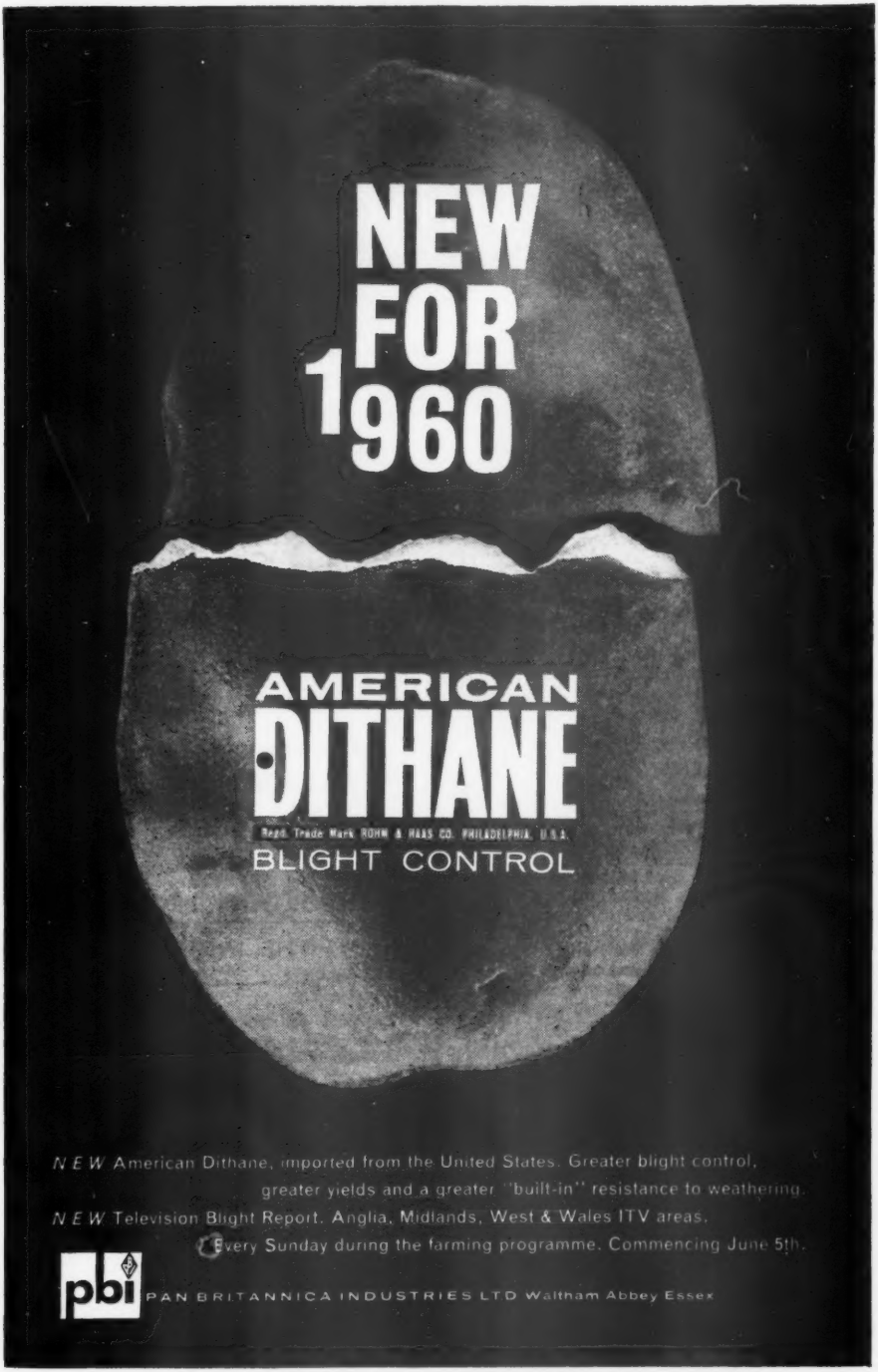
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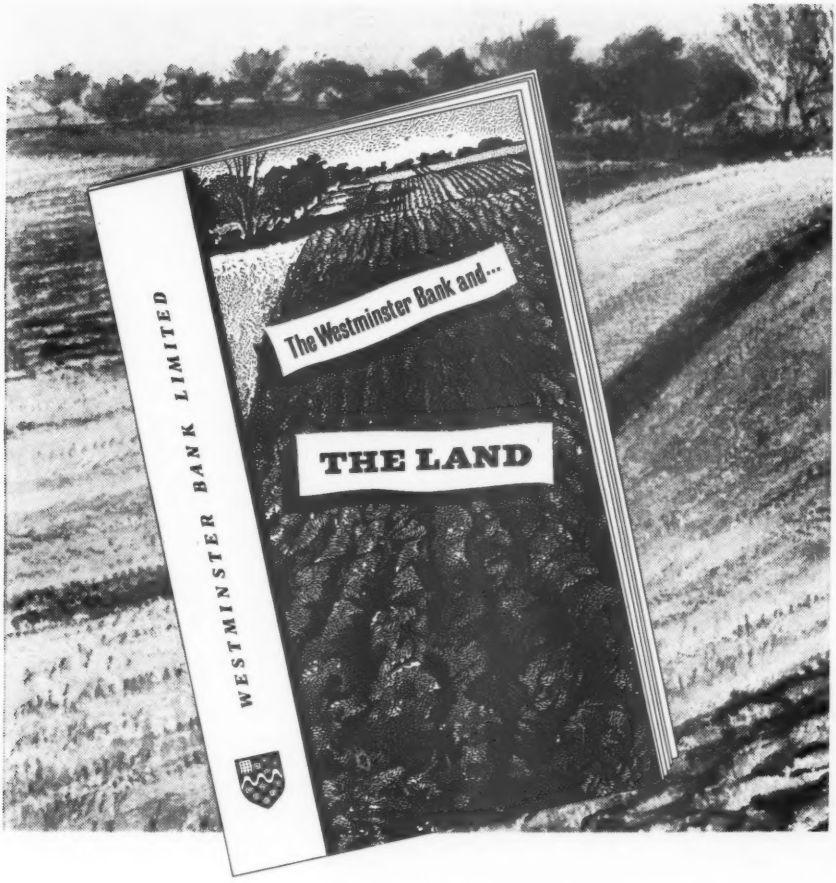

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